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A Comparative Analysis of the Resources Required for Test and Evaluation on Army-Led Weapon System Programs, Based Upon Program Size and Acquisition Management Complexity

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December 2007

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13. ABSTRACT *(maximum 200 words)*

Test and Evaluation (T&E) is an integral part of every acquisition program, as such, it consumes considerable program resources. The Department of Defense (DoD) T&E program management requirements are written to meet the risk reduction needs of large acquisition programs, but do not provide the details needed to consistently scale T&E management efforts for smaller programs across DoD. This research study investigates ways that the T&E burden to programs differs based upon the Acquisition Category (ACAT), application of T&E oversight, and materiel commodity area. The primary data source for the study was each program's Test and Evaluation Master Plan (TEMP). The majority of the programs evaluated are part of the DoD Chemical Biological Defense Program (CBDP). This research effort found ACAT-based patterns in requirements definitions and ACAT-induced variability in test site usage. The study also determined that the TEMP documentation burden was similar across all ACATs, and consistently higher than Service guidance. Future studies using this analysis methodology are required to determine whether the T&E burden to CBDP programs is typical or unique within DoD.

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A COMPARATIVE ANALYSIS OF THE RESOURCES REQUIRED FOR TEST AND EVALUATION ON ARMY-LED WEAPON SYSTEM PROGRAMS, BASED UPON PROGRAM SIZE AND ACQUISITION MANAGEMENT COMPLEXITY

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ABSTRACT

Test and Evaluation (T&E) is an integral part of every acquisition program, as such, it consumes considerable program resources. The Department of Defense (DoD) T&E program management requirements are written to meet the risk reduction needs of large acquisition programs, but do not provide the details needed to consistently scale T&E management efforts for smaller programs across DoD. This research study investigates ways that the T&E burden to programs differs based upon the Acquisition Category (ACAT), application of T&E oversight, and commodity area. The primary data source for the study was each program's Test and Evaluation Master Plan (TEMP). The majority of the programs evaluated are part of the DoD Chemical Biological Defense Program (CBDP). This research effort found ACAT-based patterns in requirements definitions and ACAT-induced variability in test site usage. The study also determined that the TEMP documentation burden was similar across all ACATs, and consistently higher than Service guidance. Future studies using this analysis methodology are required to determine whether the T&E burden to CBDP programs is typical or unique within DoD.

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LIST OF ACRONYMS

AAE	Army Acquisition Executive
ACADA	Automatic Chemical Agent Detector and Alarm
ACAT	Acquisition Category
ACTD	Advanced Concept Technology Demonstration
ADSS	ATEC Decision Support System
AEC	U.S. Army Evaluation Center
AFB	Air Force Base
AFFTC	Air Force Flight Test Center
AFMC	Air Force Materiel Command
AFMOA	Air Force Medical Operations Agency
AFOTEC	Air Force Operational Testing and Evaluation Command
AFRL	Air Force Research Laboratory
ALSI-1	Analytical Laboratory System
AMSAA	Army Materiel Systems Analysis Activity
AoA	Analysis of Alternatives
APB	Acquisition Program Baseline
APG	Aberdeen Proving Ground
ARL	Army Research Laboratory
ASARC	Army Systems Acquisition Review Council
ATC	Aberdeen Test Center
ATD	Advanced Technology Demonstration
ATEC	Army Test and Evaluation Command
ATG	Afloat Training Group
ATTC	Aviation Technical Test Center
BFV	Bradley Fighting Vehicle
BIDS	Biological Integration and Detection System
C4I	Command, Control, Communications, Computer, and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CB	Chemical and Biological

CBDP	Chemical and Biological Defense Program
CBPSS	Chemically and Biologically Protected Shelter System
CBRN	Chemical, Biological, Radiological, Nuclear
CDD	Capability Development Document
CIO	Chief Information Officer
COCOM	Combatant Commander
COI	Critical Operational Issue
COIC	Critical Operational Issue and Criteria
COMOPTEVFOR	U.S. Navy Operational Test and Evaluation Force
CPD	Capability Production Document
CR	Concept Refinement
CRTC	Cold Regions Test Center
CTP	Critical Technical Parameter
DAB	Defense Acquisition Board
DAE	Defense Acquisition Executive
DARPA	Defense Advanced Research Projects Agency
DATSD	Deputy Assistant to the Secretary of Defense
DoD	Department of Defense
DoDD	Department of Defense Directives
DoDI	Department of Defense Instructions
DoD-R	Department of Defense Regulations
DOT&E	Director, Operational Test and Evaluation
DPG	Dugway Proving Ground
DRR	Design Readiness Review
DT	Developmental Testing
DTC	U.S. Army Developmental Test Command
DTP	Detailed Test Plans
DTRA	Defense Threat Reduction Agency
DUSA	Deputy Under Secretary of the Army
EA	Evolutionary Acquisition
EDM	Engineering Development Model
EDP	Event Design Plan

EMI	Electromagnetic Interference
EOA	Early Operational Assessment
EPG	Electronic Proving Ground
FCS	Future Combat Systems
FITG	Fort Indiantown Gap National Guard Training Center
FOC	Full Operational Capability
FOT&E	Follow-On Test and Evaluation
FOUO	For Official Use Only
FRP	Full-Rate Production
FY	Fiscal Year
GAO	General Accounting Office
GPRA	Government Performance and Results Act
HEMP	High Altitude Electromagnetic Pulse
HMMWV	High Mobility Multipurpose Wheeled Vehicle
IA	Information Assurance
ICD	Initial Capabilities Document
IOC	Initial Operational Capability
IPR	In-Process Review
IPS	Integrated Program Summary
IT	Information Technology
JAP	Joint Applied Project
JBAIDS	Joint Biological Agent Identification and Diagnostic System
JBPDS	Joint Biological Point Detection System
JBSDS	Joint Biological Standoff Detection System
JCAD	Joint Chemical Agent Detector
JNBCDB	Joint Nuclear Biological Chemical Defense Board
JPACE	Joint Protective Aircrew Ensemble
JPEO-CBD	Joint Program Executive Office for Chemical Biological Defense
JPM	Joint Program Manager
JPO-BD	Joint Program Office for Biological Defense
JROC	Joint Requirements Oversight Council
JSGPM	Joint Service General Purpose Mask

JSIG	Joint Service Integration Group
JSLIST-GLOVE	Joint Service Lightweight Integrated Suit Technology Glove
JSLNBCRS	Joint Service Nuclear, Biological, Chemical Reconnaissance Vehicle
JSLSCAD	Joint Services Lightweight Standoff Chemical Agent Detector
JSMG	Joint Service Materiel Group
JSTDS	Joint Service Transportable Decontamination System
JWE	Joint Warfighting Experiments
KPP	Key Performance Parameter
LAT	Live Agent Test
LFT&E	Live Fire Test and Evaluation
LoE	Level of Effort
LRIP	Low Rate Initial Production
LUT	Limited User Test
LVOSS	Light Vehicle Obscurant Smoke System
M&S	Modeling and Simulation
MAIS	Major Automated Information System
MARCORSYSCOM	Marine Corps Systems Command
MCOTEA	Marine Corps Operational Test & Evaluation Activity
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
MIL-STD	Military Standard
MIT	Massachusetts Institute of Technology
MNS	Mission Needs Statement
MOE	Measure of Effectiveness
MOP	Measure of Performance
MOS	Measure of Suitability, Military Occupational Specialty
MS	Milestone
NASA	National Aeronautics and Space Administration
NAVAIR	Naval Air Systems Command
NAVSEA	Naval Sea Systems Command
NAWCAD	Naval Air Warfare Center Aircraft Division

NBC	Nuclear Biological Chemical
NBCRV	Nuclear, Biological, Chemical, Reconnaissance Vehicle
NCTRF	Navy Clothing and Textile Research Facility
NOMI	Naval Operational Medicine Institute
NRL	Naval Research Laboratory
NSC	Naval Safety Center
NSWC	Naval Surface Warfare Center
O&S	Operations and Support
OA	Operational Assessment
OE	Operational Effectiveness
OPFOR	Operational Force
ORD	Operational Requirements Document
OS	Operational Suitability
OSD	Office of the Secretary of Defense
OT	Operational Testing
OT&E	Operational Test and Evaluation
OTA	Operational Test Agency
OTC	U.S. Army Operational Test Command
OUSD(C)	Office Under Secretary of Defense, Comptroller
Pd	Probability of Detection
PD	Production and Deployment
PD-TESS	Product Director of Test Equipment, Strategy, and Support
PEO	Program Executive Office
PM	Program Manager
PMO	Program Manager Office
POM	Program Objective Memorandum
PPE	Personal Protective Equipment
PPT	Production Prove-Out Test
PQT	Production Qualification Test
PVT	Product Verification Test
RDECOM	Research, Development, and Engineering Command
RDT&E	Research, Development, Testing and Evaluation

RTTC	Redstone Technical Test Center
SAMP	Single Acquisition Management Plan
SBCCOM	Soldier and Biological Chemical Command
SDD	System Development and Demonstration
SECNAV	Secretary of the Navy
SHIPBRD-CPS	Shipboard Collective Protection System
SINGARS	Single-Channel Ground-Air Radio System
SPAWAR	Space and Naval Warfare Systems Command
T&E	Test and Evaluation
TD	Technology Development
TECOM	Test and Evaluation Command
TEMP	Test and Evaluation Master Plan
TES	Test/Evaluation Strategy
TEXCOM	Test and Experimentation Command
TRTC	Tropic Regions Test Center
UAV	Unmanned Aerial Vehicles
USC	United States Code
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics
USMC	United States Marine Corps
WMD	Weapon of Mass Destruction
WPAFB	Wright-Patterson Air Force Base
WSMR	White Sands Missile Range
YPG	Yuma Proving Ground
YTC	Yuma Test Center

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I. INTRODUCTION

A. BACKGROUND

The Department of Defense (DoD) and individual Service (Army, Navy, Air Force, and Marine Corps) guidance for acquisition system testing focuses primarily on large Acquisition Category I (ACAT I) programs. Therefore, managers of medium, ACAT II, and small, ACAT III, DoD programs must work closely with the Test and Evaluation (T&E) community to effectively tailor both test documentation and test scope to balance the test burden with other program requirements. A Program, Project, or Product Manager (PM) is required to execute their acquisition program within the cost, schedule, and technical constraints of the program baseline. The rest of the acquisition community, including the T&E organizations, is not constrained by these same overall goals.

Anecdotal PM Office (PMO) experiences point to historical T&E community inflexibility, especially in the tailoring of T&E documentation scope based upon program size and complexity. While some programs require specialized testing, such as laboratory chemical or biological agent testing, most general types of program tests are required across-the-board. While many of these tests are applicable to the majority of weapon systems, the scope of T&E and the associated documentation should still be tailored to strike a balance between user needs and overall program constraints. PMO experiences also point to a proclivity to document and test more, rather than less, whenever a choice must be made by the T&E activities. Requiring additional tests or more detailed documentation is unlikely to cause any personal or organizational issues for a tester, while agreeing to less of each will likely raise thorny questions.

The general PMO sense that the T&E burden, driven by the technical nature of the requirements for smaller systems, standardized T&E documentation without regard for program scope, and the lack of program-tailored test efforts were the issues that sparked this research study. The three research questions defined below were chosen specifically to investigate whether these PMO-held notions regarding T&E are justified.

B. RESEARCH QUESTIONS

1. Primary Research Question

- Is the T&E Level of Effort (LOE) proportional to a program's designated ACAT level?

2. Secondary Research Questions

- How does program oversight by the Director Operational Test and Evaluation (DOT&E) or the Army drive the T&E LOE?
- Are Chemical/Biological (C/B) programs a special case for T&E LOE?

C. SCOPE AND METHODOLOGY

1. Scope

This research study will evaluate the T&E burden for acquisition programs, based primarily on the data available in each program's TEMP. The study focuses on the CBDP within DoD, but also includes data for two ACAT I non-CBDP programs. A detailed analysis is performed to determine differences in T&E requirements, documentation burden, and other related factors that impact the scope of T&E for acquisition programs.

This study is bounded by the following conditions:

- Only programs with a TEMP containing sufficient detail for a comparative analysis were included in this study.
- Software-based programs, such as Information Technology (IT) and Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) were not evaluated.
- The inconsistent nature of program cost summaries between TEMPs, and as reported in DoD budget materials, precluded an analysis of costs, either at the program-level or for T&E efforts.

2. Methodology

A summary of the approach used to conduct this research project is:

- Conduct a literature search, of both the publicly-accessible and the For Official Use Only (FOUO) sections, of the Joint Program Executive Office for Chemical Biological Defense (JPEO-CBD) program database to acquire CBDP-specific acquisition program documents.
- Gather publicly-available funding data on CBDP programs from the DoD budget materials contained on the Office of the Under Secretary of Defense, Comptroller (OUSD(C)) web site to supplement program-specific acquisition documents.
- Investigate the availability and usefulness of detailed T&E documents, such as Detailed Test Plans (DTPs) and Event Design Plans (EDPs), and gather information on tests conducted by the Army Test and Evaluation Command (ATEC) using their ATEC Decision Support System (ADSS).
- Perform electronic searches to identify reports, theses, congressional testimony, and periodical articles related to T&E and the CBDP.
- Review the collected information to determine whether or not each data type has the potential to contribute to research question answers.
- Determine the core set of documents required for the analysis.
- Request copies of core documents for non-CBDP programs to support a comparative analysis of T&E LoE for CBDP and non-CBDP programs.
- Extract all potentially useful data elements from several documents and perform a preliminary analysis to determine what, if any, top-level or derived relationships exist within the data that can contribute to research question answers.
- Finalize the data analysis approach and perform the analysis based on the relationships identified above.
- Formulate conclusions and recommendations based upon the results of the analysis, taking the study's limitations into account. Provide suggestions for future related study.

D. ORGANIZATION OF STUDY

This Joint Applied Project (JAP) contains the information necessary to understand this research effort; starting with this introduction, followed by a background section, a data summary, data analysis, and conclusions and recommendations. Additional information is included at the end of this project paper to define the acronyms used, provide facts on the programs investigated, list all references used, and to define the initial distribution for the document. Additional details for each major chapter in this document are listed below.

Chapter I: Introduction. This chapter describes the rationale behind performing this research study, defines the research questions guiding the effort, defines the scope and methodology used, defines the JAP organizational structure, and lists several beneficial outputs of this study.

Chapter II: Background. Chapter II provides the basic knowledge needed to understand the data, analysis, and conclusions presented in this JAP. It begins with an introduction to the acquisition process, including definitions of the acquisition categories used by DoD to determine management processes. Since all but three of the programs studied fall within the CBDP, the history and organizational structure of the CBDP follows. The chapter concludes with an overview of T&E, presented in four parts; the basis for T&E and the TEMP, test types, program oversight, and a review of the T&E organizations used by the programs in this study.

Chapter III: Data Summary. The data collected and analyzed in this JAP is presented in this chapter, along with a discussion that characterizes all of the data collected during this research The data is partitioned into three categories: principle data, which is the primary information source for analysis in Chapter IV; secondary data, which only indirectly supports answers to the research questions; and unavailable, inconsistent, and/or deficient data, which encompasses information that either was not available or could not effectively be analyzed.

Chapter IV: Data Analysis. This chapter analyzes the data presented in Chapter III, and presents the results obtained. The limitations and scope of the analysis are discussed to define the limits of the results, develops a three-pronged approach to execution, and then uses this approach to analyze the data. The three focus areas for the analysis are: system requirements, documentation, and test management scope.

Chapter V: Conclusions and Recommendations. The results of the analysis presented in Chapter IV are rolled-up into overall conclusions and recommendations in this chapter. The answers to the research questions defined in Chapter II are presented with supporting rationale. Recommendations for future academic study and for T&E program implementation within DoD are also presented. Finally, an overall summary of the research effort is presented.

E. BENEFITS OF THE STUDY

A PM's ability to balance all aspects of an acquisition program to meet cost, schedule, and performance requirements depends upon many factors. T&E is both an essential risk reduction element and a large programmatic burden. Balancing program T&E efforts, in accordance with program size, system complexity, budget, and schedule is critical to the successful acquisition of new capabilities for the war-fighter.

DoD provides T&E guidance, targeted primarily for ACAT I programs. This study investigates whether program requirements, documentation, and test scope are tailored due to a program's ACAT, OSD/DOT&E oversight status, and materiel commodity area. The key outputs of this study are: a methodology that can be applied DoD-wide to determine technical versus operational requirements drivers for T&E, the characterization of the TEMP documentation burden by ACAT, insights into the effects of oversight on ACAT III programs, and – with the help of future research efforts – the ability to determine whether the T&E burden for CBDP efforts is unique or typical within DoD.

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II. BACKGROUND

Galileo Galilei said, “All truths are easy to understand once they are discovered; the point is to discover them.” [1] While the discovery of ‘truths’ is the goal of any research study, the task is nearly impossible without first gaining a basic understanding of the area of interest. Therefore, this chapter provides the background information needed to understand the area of this research effort, which is Test and Evaluation (T&E) within the framework of the Department of Defense (DoD) acquisition process.

This chapter begins with a top-level introduction to the DoD acquisition process and program acquisition category designators, followed by an overview of the Chemical and Biological Defense Program (CBDP) – which is the primary domain of the programs studied. Finally, the chapter discusses the rationale for T&E, the types of DoD T&E efforts, introduces program oversight, and provides a summary of the T&E organizations reviewed.

A. DOD ACQUISITION OVERVIEW

1. The Acquisition Life-Cycle Process and T&E

The acquisition of new products within DoD has evolved significantly over the past few decades. Major changes include the addition of the requirement for independent operational test agencies within each Service; the creation of the Congressional oversight organization, the Director of Operational Test and Evaluation (DOT&E); and the sweeping acquisition reform initiatives implemented in 1994 and 1995 by the Secretary of Defense, Dr. William Perry. Many of these changes were targeted at improving the T&E aspects of the acquisition process.

An overview of the current DoD acquisition life cycle is depicted in Figure 1. The acquisition of new products for DoD has proven to be a lengthy and inherently risky management challenge. This multi-phased life cycle approach is designed to focus acquisition efforts to reduce risk, with T&E a key risk reduction tool. The life cycle starts with Concept Refinement (CR) and Technology Development (TD) before formal system acquisition begins, proceeds to formal acquisition with System Development and Demonstration (SDD) and Low Rate Initial Production (LRIP) followed by Full Rate Production (FRP), and completes with the Operations and Support (O&S) phase. A more detailed discussion of each phase and the top-level T&E elements in each follows. A brief discussion of each test type will be presented in Section A.2 of this chapter.

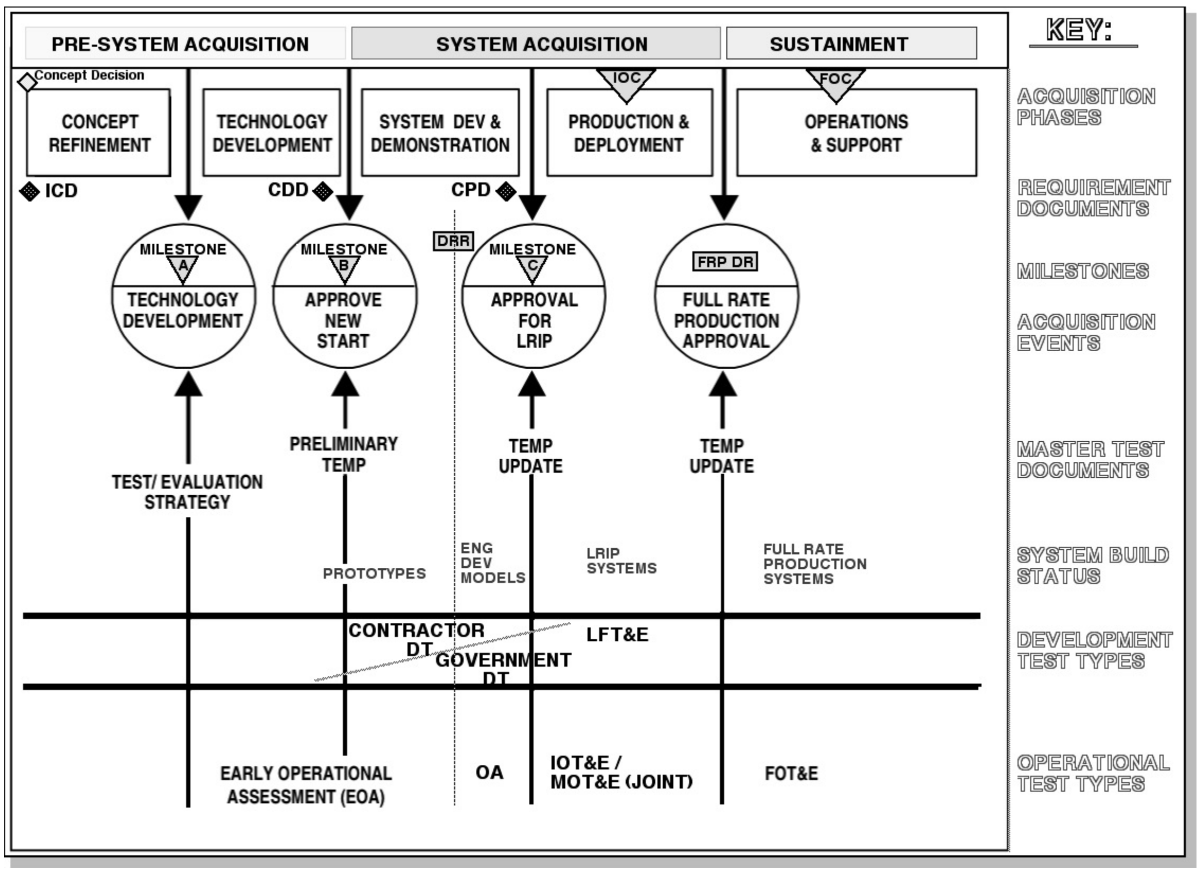

Figure 1. DoD Acquisition Life Cycle. (After: [2, p. 2-2])

During the CR phase, a conceptual technology approach is developed, based on an analysis of available technology alternatives. The Joint Requirements Oversight Council (JROC)-validated Initial Capabilities Document (ICD) is the requirements document that guides these efforts. Analysis of existing data in order to develop a viable approach is predominant in this early phase. Some Modeling and Simulation (M&S) and limited laboratory testing to prove the viability of the concept selected may also occur.

Milestone A (MS A) marks the end of the CR phase, and is the decision point to determine whether to proceed into TD. The first overarching T&E document for the program, the Test/Evaluation Strategy (TES), is also completed by the end of CR.

In the TD phase, the viability of the technology approach selected is proven. Prototype subsystems and components are developed and technically tested, and more targeted M&S and laboratory testing may also be conducted to determine the limits and maturity of the chosen technologies. By the end of the TD phase, several key documents are formalized, including the first version of the program TEMP, the JROC-validated Capability Development Document (CDD), and an Early Operational Assessment (EOA) which assesses the operational impacts of the technology approach. Milestone B (MS B) ends this phase and is the decision point for the initiation of a new acquisition program. In addition, MS B marks the closure of the ability of programs to request either a partial or a full waiver from Live Fire T&E (LFT&E).

After a successful MS B decision, the acquisition program officially enters the SDD phase. A Program Manager (PM) is assigned and delegated, through a formal charter, cost, schedule, and performance responsibility for the program. SDD is broken into two sub-phases, system integration and system demonstration, with the Design Readiness Review (DRR) as the dividing gate. Prior to the DRR, the prototype and subsystem development efforts that began in TD, continue, with the goal to develop fully functional elements for incorporation into working system Engineering Development Models (EDMs). After the DRR, the EDMs are tested to determine the design's ability to meet the CDD requirements. In addition to technical tests, one or more Operational Assessments (OA) are performed during SDD to determine whether the system has the potential to be both operationally effective and suitable. At the end of SDD, the TEMP is updated and the JROC-validated Capability Production Document (CPD) is completed. Milestone C (MS C) completes this acquisition phase.

A program enters Production and Deployment (PD) and begins LRIP after MS C. The initial LRIP systems are primarily used for T&E, which includes IOT&E for single-Service programs or MOT&E for joint programs, system-level LFT&E, and technical tests to verify production fixes for any technical issues found with the engineering development models from SDD. Later, LRIP systems are also typically fielded after successful completion of testing in order to provide the system's Initial Operational Capability (IOC). The TEMP is updated again for the Full Rate Production Decision Review (FRPDR), to include any additional testing required on FRP systems, such as Follow-On T&E (FOT&E), as a result of tests on the LRIP systems.

The dividing line between FRP and the final phase of acquisition, Operations and Support is not as clear-cut as with the previously discussed boundaries. This is due to the overlap of system support for early-fielded units and the production and deployment of systems to units with later fielding dates. FOT&E is conducted using FRP systems, if required, during this phase. Once all planned systems have been fielded, the Full Operational Capability (FOC) has been achieved. O&S, or sustainment, activities also include any tests required due to system problems identified after fielding, user support, and system disposal activities.

2. DoD Acquisition Categories (ACAT)

The Department of Defense organizes acquisition programs into three Acquisition Categories (ACATs): ACAT I, ACAT II, ACAT III. The ACAT assigned to a program is primarily based on the level of funding required to execute the development and production program activities, however program complexity and risk are other factors that can also drive the final ACAT determination. The ACAT assigned to a program also determines the types and level of reviews and the assigned Milestone Decision Authority (MDA), with some requirements determined by statute. DoD also executes non-standard development programs, such as Advanced Concept Technology Demonstrations (ACTDs), Advanced Technology Demonstrations (ATDs), and Joint Warfighting Experiments (JWEs). A summary of the characteristics of each ACAT, including funding criteria, milestone review forum, and MDA is shown in Figure 2.

Table 3–1
Categories of acquisition programs and milestone decision authorities

Program category	Program management	Primary criteria ($ = FY2000 constant)	Milestone review forum	Milestone Decision Authority
ACAT I				
ACAT ID	PEO/PM	more than $365M RDTE more than $2.19B Proc	DAB	DAE (USD(AT&L))
ACAT IC	PEO/PM	more than $365M RDTE more than $2.19B Proc	ASARC	AAE
ACAT IA				
ACAT IAM	PEO/PM	excess of $32M single year excess of $126M total program excess of $378M total life-cycle costs	DOD CIO review	DOD CIO (ASD(NII))
ACAT IAC	PEO/PM	excess of $32M single year excess of $126M total program excess of $378M total life-cycle costs	ASARC	AAE
ACAT II				
ACAT II	PEO/PM	more than $140M RDTE more than $660M Proc	ASARC	AAE[1]
ACAT III				
ACAT III	PEO/PM	Non-major (including C4/IT) systems (No fiscal criteria)	IPR	Designated by the office of the AAE

Notes:
[1] The AAE may redelegate MDA authority at his discretion to a level no lower than the PEO (GO/SES) level. Where applicable, in the areas of medical research and development, Army chaplaincy or Public Affairs, the MDA may be the commander of a systems or materiel command for ACAT II and III programs.

Figure 2. ACAT Definitions. (From: [3])

An ACAT I is normally considered a Major Defense Acquisition Program (MDAP), and encompasses the largest defense programs. ACAT I programs are further divided according to specific oversight requirements and the type of program. ACAT IA and ACAT IAM designations are for Major Automated Information System (MAIS) programs. ACAT ID and IC programs differ primarily in the milestone review forum and the MDA assigned to the program.

ACAT) II programs are acquisition programs that do not meet the criteria for an ACAT I program, but do meet the criteria for a major system, or have been designated as a ‘special interest’ program by the MDA.

ACAT III programs are non-major programs that have the MDA designated by the AAE or CIO. These programs use In-Process Reviews (IPRs) as the milestone review forum.

The majority of programs within the CBDP are ACAT III-level, with the larger programs designated as ACAT II. Other ACAT I-D programs, such as the Stryker

Nuclear, Biological, Chemical, Reconnaissance Vehicle (NBCRV), incorporate CBDP mission packages, but are still managed by non-CBDP organizations with JPEO/JPM support.

B. THE CHEMICAL AND BIOLOGICAL DEFENSE PROGRAM

The overwhelming majority of programs evaluated for this project, 20 of 23, are managed as part of the Chemical and Biological Defense Program within DoD. Additionally, one of the other three programs includes a fully-integrated CBDP-managed mission equipment package. Therefore, a basic knowledge of the CBDP is essential to understanding all aspects of this report. This section outlines the history of the CBDP, with a focus on organizational structure, defines the commodity areas within the CBDP, and describes the unique aspects of the CBDP T&E management structure.

The CBDP was established in 1994 to provide for centralized management and control of all DoD Chemical and Biological (CB) defense programs. This action was in response to Public Law No. 103-160, Section 1701 (50 USC 1522) which "mandates the coordination and integration of all Department of Defense CB defense programs." [4] Deficiencies in DoD's CB defense capabilities identified during Operation Desert Storm (ODS) provided much of the impetus for Congress to mandate improvements in CB defense management.

The CBDP was initiated using the management structure shown in Figure 2. This organizational scheme provided DoD-level oversight of service-specific CB program offices. Within this structure, the Joint Service Integration Group (JSIG) was tasked with oversight and guidance on training, doctrine, and requirements to ensure that service-specific and warfighting Combatant Commanders (COCOMs) requirements and priorities for acquisition were met. The Joint Service Materiel Group (JSMG) was responsible for the CB technology, sustainment, and research and development of CB items to mitigate program-wide risk and to minimize duplication of efforts across commodity areas. The JSIG and JSMG were under to the Joint Nuclear Biological Chemical (NBC) Defense Board (JNBCDB) which reported to the NBCD Steering Committee. Additionally, the Joint Program Office for Biological Defense (JPO-BD) was linked to both the JNBCDB and the medical program within DoD. Figure 3, extracted from page 23 of the General Accounting Office (GAO) report GAO/NSIAD-99-159, shows a slightly different view of the CBDP, with the inclusion of the Soldier and Biological Chemical Command (SBCCOM) as a complimentary material development organization to the JPO- BD.

The CBDP commodity areas, with the lead Services designated in 1994, are listed below. Descriptions of all but the last commodity area are extracted from Chapter 2 of the 1994 CBDP Annual Report to Congress. The description of modeling and simulation is a CBDP-focused version of the M&S definition in DoD5000.59-M.

- Contamination Avoidance – Army. NBC reconnaissance, detection and warning.
- Individual Protection – Marines. Protective masks and protective clothing.
- Collective Protection – Navy. Shelters for command posts, rest and relief, vehicular collective protection, and safe zones aboard ship.
- Decontamination – Air Force. Systems used to reduce or eliminate hazards to units after exposure to NBC contamination.
- Medical Defense – Army. Medical prophylaxis, pretreatment, and therapies used to protect personnel from the toxic or lethal effects of NBC threat agents.
- Modeling and Simulation – Navy. The use of models, including emulators, prototypes, simulators, and stimulators, to develop data for making decisions related to CB defense activities.

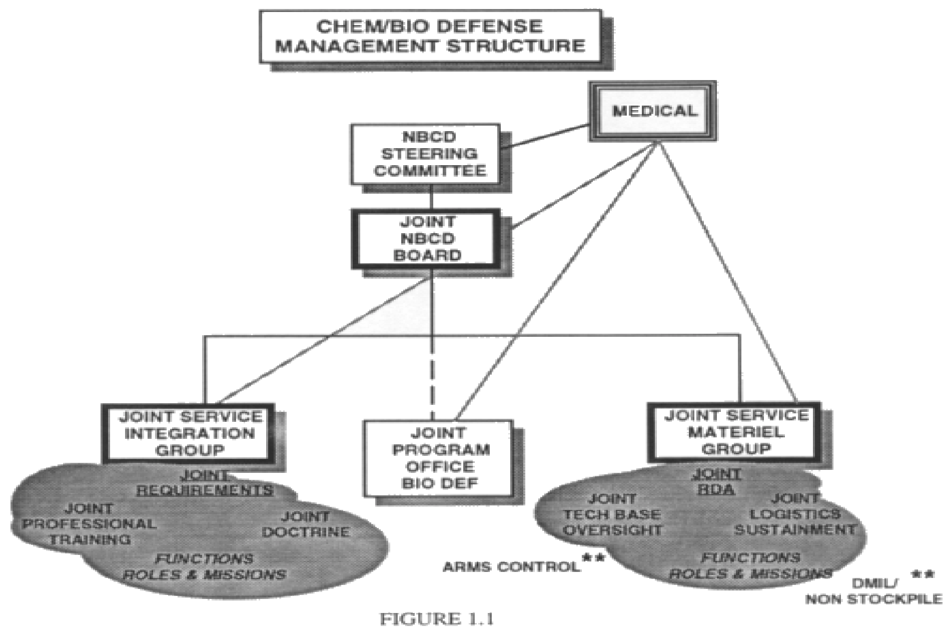

Figure 3. Initial CBDP Management Structure. (From: [5])

Figure III.1: Primary Planning and Executing Organizations and Programs of DOD's Chemical and Biological Defense Program Research, Development, Test, and Evaluation

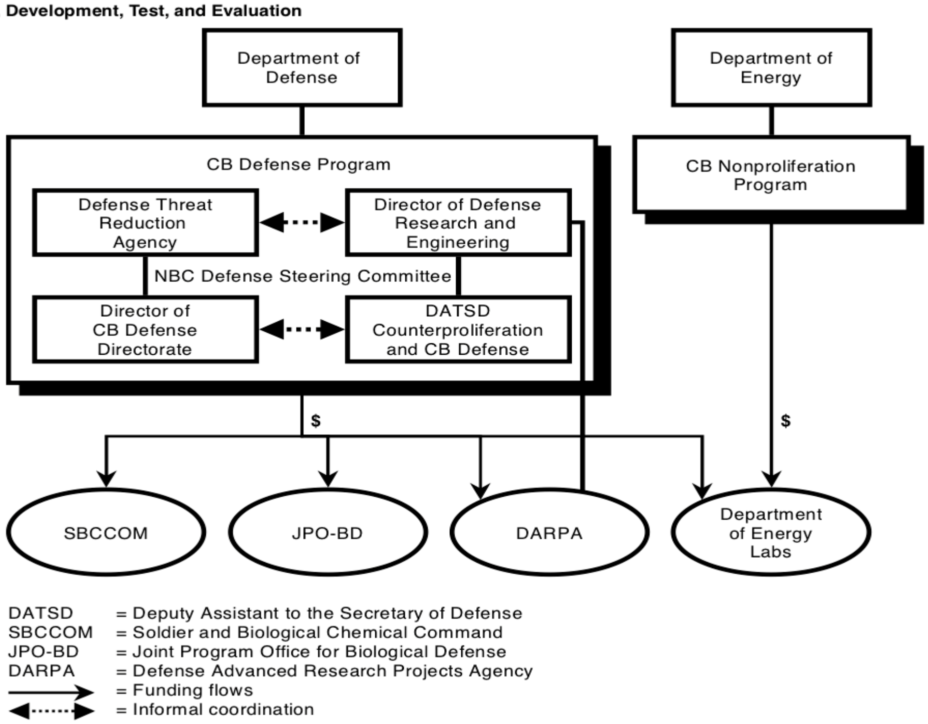

Figure 4. CBDP Planning and Executing Organizations (From: [6, p. 23])

The Secretary of the Army was designated as the CBDP Executive Agent, and as such is "responsible to coordinate, integrate, and review all Services' CB defense requirements and programs." [7] In this organizational structure the individual Services executed programs to meet Service-specific and DoD requirements. In 1997 the Defense Threat Reduction Agency (DTRA) was established, and given responsibility for CBDP budgeting.

These changes to CB defense execution within DoD were an improvement over previous practices but still did not vastly improve efficiencies of operation within the CBDP. In Figure 4, the 1999 GAO report GAO/NSIAD 99-159 recommended that an outcome-oriented performance plan for the CBDP be developed based on the principles in the Government Performance and Results Act (GPRA). The GAO stated that the "Goals of the CB Defense Program Are Vague and Unmeasurable and Do Not Articulate Specific Desired Impacts," and that "CB Defense Program Performance Measures Emphasize Activities Rather Than Outcomes and Impacts." Implementation of results-based management was inconsistent, with "The Soldier and Biological Chemical Command (SBCCOM)" as "the Only RDT&E Organization to Systematically Apply Results Act Principles."

These lingering deficiencies prompted major organizational changes to the CBDP in 2001 with the creation of the Program Executive Office (PEO) for Chemical and Biological Defense, which became the Joint PEO for Chemical and Biological Defense (JPEO-CBD) in 2003. The JPO Biological Defense functions were incorporated into the PEOs. This new, and also current, organizational structure for the CBDP is shown in Figure 5. This layout is designed to resolve issues inherent in previous CBDP implementations, such as single service control of programs, rampant duplicative efforts, disconnects between the development and test organizations, and a lack of oversight effectiveness.

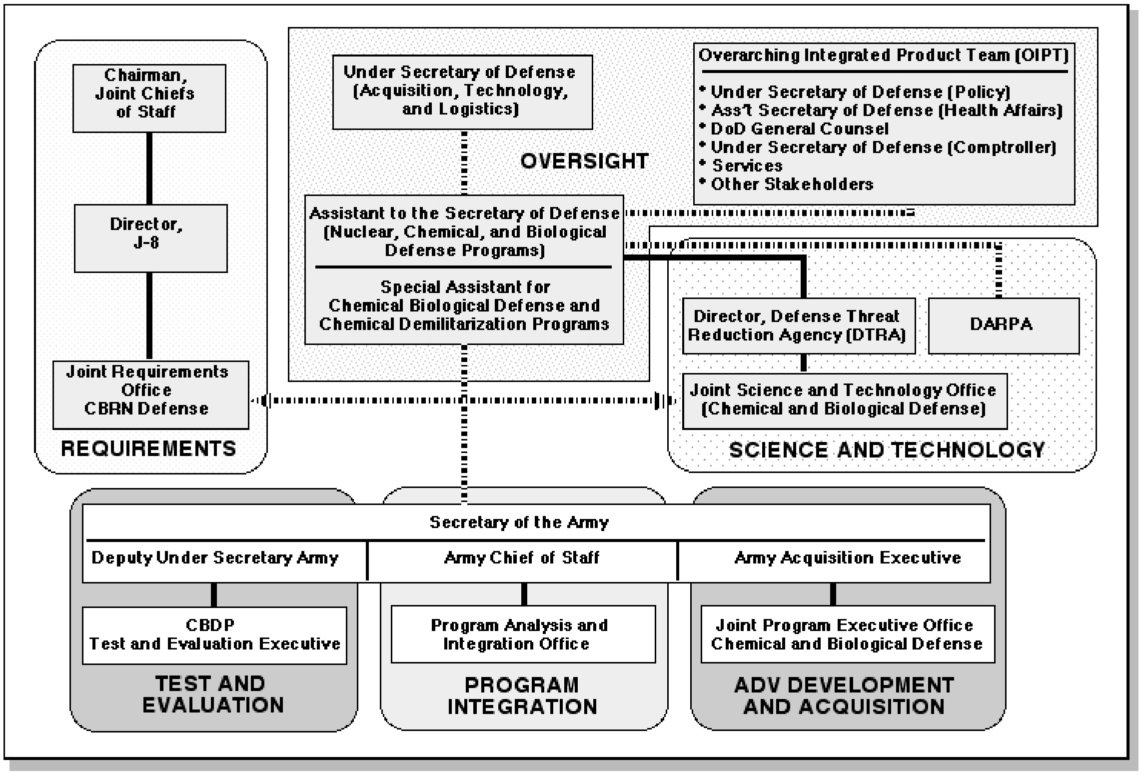

Figure 5. Current CBDP Management Structure (From: [8, p. 2])

This change maintains the commodity-based structure implemented in the mid-1990s, with two modifications; it breaks large biological detection programs into a separate JPM and adds a JPM focused on installation protection within the United States. Since CBDP funds are centrally budgeted under the defense-wide, rather than service-specific, category, the JPEO and JPMs manage programs that are truly joint, rather than single-service-driven with joint 'potential' or joint 'interest.'

The JPEO-CBD includes eight Joint Project Managers (JPMs), primarily aligned by commodity areas. The JPMs with their functional areas of responsibility are:

- JPM NBC Contamination Avoidance (Army)– NBC detection, obscuration, and reconnaissance
- JPM Biological Defense (Air Force) – Biological detection
- JPM Collective Protection (Navy) – CBR collective protection
- JPM Individual Protection (Marines) – CBR individual protection
- JPM Decontamination (Marines) – Individual and equipment decontamination

- JPM CB Medical Systems (Army) – Medical treatment, vaccines, and identification
- JPM Information Systems (Army) – CB C4I and models and simulations
- JPM Guardian (Army) – Installation protection

This CBDP organizational layout centralizes management of all Service CB defense acquisition programs under the JPEO-CBD. This structure aligns with the existing designation of the Army as the Executive Agent for the CBDP, and more importantly, provides a single reporting chain for CBD acquisition programs within DoD. Requirements are handled jointly by the Joint Requirements Office (JRO) for Chemical, Biological, Radiological, Nuclear (CBRN) defense while CB Science and Technology is separately managed by the Joint Science and Technology Office (CBD) within the Defense Threat Reduction Agency (DTRA). Chapter 1 of the 2007 CBDP Annual Report provides a more detailed description of the roles and responsibilities of all CBDP organizations.

Oversight of the CBDP as an entity, with the CBDP designated as an ACAT I-D program (non-MDAP) is provided by the Special Assistant for CBD and Chemical Demilitarization Programs within the Assistant to the Secretary of Defense (Nuclear, Chemical, and Biological Defense Programs) office. [9] Additionally, individual programs may also be under DOT&E oversight and/or be designated as Defense Acquisition Executive (DAE) 'Sentinel' oversight programs within the CBDP.

For T&E, the Deputy Under Secretary of the Army (Operations Research) (DUSA(OR)) has responsibility as both the Army and the CBDP T&E executive. This enables the Secretary of the Army to hold both the materiel development executive, the JPEO-CBD, and the test executive, the CBDP T&E Executive, accountable for programs within the CBDP.

Another CBDP-unique organization is the Product Director of Test Equipment, Strategy, and Support (PD-TESS) within the office of the JPM NBC Contamination Avoidance. The PD TESS is chartered "to support the CBDP T&E Executive in matters of test infrastructure development." [8, p. 63] The PD TESS is tasked to manage upgrades to the CBDP test infrastructure (e.g., CB agent test facilities) through FY11 to address existing test facility limitations to effective CB test execution.

In summary, the one and a half billion dollar per annum CBDP is a congressionally-mandated, uniquely-managed, joint enterprise within the DoD. It has taken a decade for DoD to implement an effective management and oversight structure for the CBDP, to include a separate CBDP T&E Executive, an organization dedicated to test infrastructure improvement, and to provide acquisition program responsibility to a single truly joint organization.

C. INTRODUCTION TO DOD TEST AND EVALUATION

1. The Basis for Test and Evaluation and the TEMP

The two basic reasons that T&E is performed are: to meet legal and procedural requirements, and to determine whether a system can meet the performance requirements levied upon it. While acquisition programs develop many test-related documents, it is the TEMP that is the keystone for program T&E efforts.

a. Legal and Procedural Basis for T&E

The formal requirement to perform T&E within DoD is derived from multiple sources, including public laws, statutes, executive orders, and public policies. DoD uses these sources to develop the policy memorandums, DoD Directives (DODDs), Instructions (DODIs), and Regulations (DOD-Rs) that implement these requirements. Per DoD Directive 5000.1, it and DoD Instruction 5000.2, define "management principles and mandatory policies and procedures for managing all acquisition programs." These details include definition of key T&E activities and documents, and form the basis for the development of lower-level documents, such as service-specific policies and implementation guidance. Examples of Service-specific T&E implementation documents include Army Regulation 73-1, DA Pamphlet 73-1, Air Force Policy Directive 99-1, Secretary of the Navy Instruction 5000.2, and Marine Corps order 3960.2B.

b. Operational Basis for T&E

Even if the legal and procedural requirements did not exist, there still would be a driving force behind the need for T&E – verifying that a system meets the user's operational requirements. A system must provide a technical capability that the end user can utilize to meet a mission need, i.e., the system must be operationally effective and suitable for the warfighter. The user-driven need for T&E is clearly summarized by

> T&E must demonstrate capabilities **today** that will be needed **tomorrow** in combat. When a system is called for combat duty, the need is immediate and there's no time to reconsider if the system will operate as designed. Warfighters need assurance that when they risk their lives, the systems provided will do the job for which they were designed. [10, p. 7]

c. The Role of the TEMP in T&E

DoD Instruction 5000.2 defines the requirement for a TEMP, and per Table E3.T2., requires completion of the initial version of a TEMP for an acquisition program by MS B, with updates for the MS C and the FRP decisions. DA Pamphlet 73-1 summarizes the role of the TEMP as "the basic planning document for all life cycle T&E related to a particular system acquisition and is used by decision-making bodies in planning, reviewing, and approving T&E activities." [11, p. 3] The DA Pamphlet further defines the TEMP as the "overarching T&E document used by the T&E community to generate detailed T&E plans and to ascertain schedule and resource requirements associated with the T&E program." [11, p. 3]

The Program Manager (PM) is tasked with development of the TEMP, and specifically with the technical, or developmental, T&E objectives included in the TEMP. The Operational Test Agency (OTA) is responsible for developing the OT&E objectives within the TEMP. Each system objective is described in the TEMP, typically with technical parameters called Critical Technical Parameters (CTPs) and operational parameters called Critical Operational Issues (COIs), Measures of Effectiveness (MOE), Measures of Suitability (MOS), or Measures of Performance (MOP). Objectives categories may also include items such as system survivability and interoperability.

Per DA Pamphlet 73-1, CTPs "are measurable critical system characteristics that, when achieved, allow the attainment of operational performance requirements." [11, p. 4] The key word in this phrase is 'allow,' which shows that CTPs define the technical capability that is required to make the desired operational result possible.

In contrast, operational test parameters are directly based upon the COIs, COI and Criteria (COICs), and Key Performance Parameters (KPPs) from the system's requirements document, from which the operational test evaluation requirements, the MOE, MOS, and MOP, are derived.

Two types of performance measures, technical and operational, are the key parameters used during T&E efforts to determine whether a system can meet the user's operational requirements. Although each TEMP is program-specific, all "shall describe planned developmental, operational, and live fire testing, including measures to evaluate the performance of the system during these test periods; and integrated test schedule; and the resource requirements to accomplish the planned testing." [12, p. E5.1.4.1] Since the TEMP must include all of the items necessary to execute the T&E efforts, it, therefore, is the one acquisition document that provides the information necessary for a comparative analysis of programs across acquisition categories, functional areas, and time periods.

2. Types of DOD and Commercial Testing

In this age of rapidly-advancing technologies, military weapon systems, air and ground vehicles, and support equipment are becoming increasingly difficult to acquire, maintain, and deploy into a combat environment. The demand for SMART technology, super battle-hardened equipment, and embedded software, tangled with millions of line of code, pushes the envelope of defense system complexity. The resulting increased risk to cost, schedule, and performance baselines will have a momentous effect upon the way DoD conducts T&E to verify technical parameters and validate operational performance. Currently, DoD conducts single-tiered, event-driven Developmental Testing (DT) and

Operational Testing (OT) overlapping with the contractor testing activities. Embedded within DT and OT is a host of pre and post-Full Rate Production (FRP) sub-testing events. Additionally, many program offices are choosing combined DT/OT, streamlining the T&E activities in efforts to mitigate cost and schedule risk. Regardless of the strategies employed, program offices must adhere to applicable laws, regulations, and oversight authorities when planning and conducting the numerous T&E efforts in support of an acquisition program. Consequently, this rigorous and expensive process enables the fielding of reliable products and promotes user confidence.

Modern developmental testing assesses the accomplishment of meeting critical technical parameters and determines system readiness to proceed to the Initial Operational Testing (IOT). [13, p. 16] Shown in Figure 1, DT is typically conducted throughout the Conceptual Refinement, Technology Development, and System Development and Demonstration phases, even continuing up through FRP, when involved in an Evolutionary Acquisition (EA) process. DT is an engineering tool that supports critical decisions on the choices of design plans, materials, manufacturing processes, and new or legacy technology integration. Contractor testing is typically conducted during the Conceptual Refinement and Technology Development phases, and continually monitored by the program office in preparation for testing and entrance criteria for major milestone decisions. Essentially, developmental testing minimizes design and integration surprises, which in some cases, can be fatal to an acquisition program. These pre-FRP tests are termed Product Verification Test (PVT), Production Qualification Test (PQT), Limited User Test (LUT), Live Fire Test (LFT), and the special testing requirements for the JPEO-CBD programs, Live Agent Test (LAT). For a description of these and other types of pre-FRP testing listed below, refer to Army Regulation 73-1.

- Research effort or test
- Technical feasibility test
- Engineering development test
- Production prove-out test (PPT)
- Software qualification test

- Live fire test for vulnerability & lethality
- Logistics demonstration
- C4I/IT interoperability certification test
- Software development test (SDT)

Operational testing provides qualitative and quantitative data for system assessments and evaluations, and determines operational effectiveness, suitability, and survivability of the system under realistic battlefield conditions. OT is controlled by an independent agency, using production-representative systems, while allowing restricted contractor involvement to minimize bias, and essentially supports a decision to pass or fail a defense system before it goes into full-scale procurement.

Refer to AR Regulation 73-1 for a description of the various operational tests.

- First article test
- Comparison test
- Live Fire Test, if required for product improvements of covered systems
- Quality conformance (acceptance) inspection
- Tests in support of post-deployment software support (PDSS)
- C4I/IT interoperability recertification test
- Surveillance test.
- Reconditioning test.

A unique set of requirements for Chemical, Biological, Radiological, and Nuclear defense systems is Live Agent Testing. LAT refers to the introduction of weapons-grade chemical or biological contaminants, also known as Weapons of Mass Destruction (WMD) in solid, liquid, and vaporous forms to the system being tested. Detection systems' performance is quantitatively characterized by measurements associated with the speed and rate of detection and agent concentration. Additionally, the introduction of common battlefield materials, such as fuels, solvents, lubricants, smokes and obscurants, etc., determines the detector's potential to false alarm.

Testing collective protection systems, such as filtration equipment, in mobile laboratories, shelters, and combat vehicles determines the system's ability to safely collect chemical and biological agents while providing breathable air to the occupants. Testing individual protection systems, such as Personal Protective Equipment (PPE), i.e.

masks, gloves, boots, and protective clothing determines if the product adequately shields the wearer from the agent for a given mission time requirement. Operational testing with live agents is neither practical, safe, nor legal in the continental United States. Therefore, testers and evaluators use simulants for field testing with actual users. Simulants are an effective testing method for safely replicating CBRN environments in military operations.

3. Program Oversight

One of the factors affecting many programs is oversight. Oversight is "Senior Executive-level monitoring and review of programs to ensure compliance with policy and attainment of broad program goals." [10, p. 66] Programs can be designated for oversight based on statutes and regulations, and by designation by organizations such as, the Under Secretary of Defense (Acquisition, Technology, and Logistics) (USD(AT&L)), DOT&E, or a Service. Oversight can be specific to one aspect of a program, such as T&E, or general in nature, where all key program documents and decisions require oversight-organization approval. The two types of oversight evaluated during this study were, the Office of the Secretary of Defense (OSD) T&E oversight/DOT&E oversight and CBDP-specific oversight.

OSD oversight is primarily focused on T&E, and therefore is tightly coupled with the congressionally-mandated DOT&E oversight function. DOT&E ultimately reports to Congress, but is organizationally situated within DoD. Within USD(AT&L), the Director of DT&E/Office of Defense Systems (DS) designates programs for OSD T&E oversight jointly with DOT&E, in consultation with Service (and CBDP) T&E executives, per DODI 5000.2. The 2007 OSD T&E oversight list, although marked as For Official Use Only (FOUO), is publicly accessible at the following website, http, //www.acq.osd.mil/sse/as/docs/2007_TE_Oversight_List.pdf. The OSD oversight list includes ACAT I and IAM, II, III, special interest, pre-MAIS, and pre-MDAP programs, and therefore OSD/DOT&E oversight is not unique to large programs.

Another type of oversight, called "Sentinel," existed within the CBDP from April 2003 through September 2007. Sentinel was a program-wide oversight activity performed by the USD(AT&L) on CBDP advanced development programs that had the cost, complexity, and criticality sufficient to warrant monitoring the program's cost, schedule, and performance "as an indicator of the general programmatic health of the functional area." [9] Sentinel oversight and OSD oversight were not mutually exclusive. Therefore, some programs within the CBDP had both types of oversight simultaneously. Sentinel oversight is not separately evaluated in this study, as all Sentinel systems reviewed were already on the OSD T&E oversight list.

4. Testing and Evaluation Organizations

Today, many DoD acquisition programs utilize numerous testing options available from the different services and private industry. While a substantial portion of developmental testing is the responsibility of the contractor, the majority of developmental and operational testing and evaluation of DoD systems occurs at military T&E facilities. The Department of Defense acquisition program offices are responsible for early coordination with these organizations, and typically dedicate a portion of the office staff to the responsibility of managing the program test and evaluation activities. The areas of responsibility characteristically includes defining test scope and objectives, documentation, and T&E funding, in addition to coordinating all of the test resources throughout each phase of the acquisition process. [2, p. 4-1] Consequently, the PMO's dedicated T&E activity must possess a comprehensive knowledge of the system and T&E process, and discuss alternatives associated with selecting the appropriate support activity for an effective test and evaluation strategy.

This section familiarizes the reader with various test and evaluation activities throughout DoD, however, limited to those agencies covered under the Data Summary and Data Analysis chapters.

a. Army T&E Agencies

The Army Test and Evaluation Command (ATEC) is headquartered in Alexandria, Virginia, and is DoD's single-most integrated testing and evaluation operation. ATEC comprises integrated evaluations conducted at the U.S. Army Evaluation Center (AEC), developmental testing at the U.S. Army Developmental Test Command (DTC), and operational testing at the U.S. Army Operational Test Command

(OTC). On October 1, 1999, the Army finalized the earlier decision to move developmental and operational evaluation into a single, integrated command. Figure 6 represents the Army's current organizational chart that identifies the major commands and subordinate centers.

> The Test and Evaluation Command (TECOM) became a major subordinate command of ATEC and was redesignated the U.S. Army Developmental Test Command (DTC), with DTC headquarters remaining at Aberdeen Proving Ground, Maryland. Also, the Test and Experimentation Command (TEXCOM) was redesignated the U.S. Army Operational Test Command (OTC), with OTC headquarters remaining at Fort Hood, Texas. The third ATEC subordinate command that was redesignated encompassed both the Operational Evaluation Command and the Evaluation Analysis Center, which were combined to form the new U.S. Army Evaluation Center (AEC). [14]

DTC is headquartered at the Aberdeen Proving Ground (APG), Maryland, and is responsible for the planning and management activities of all developmental testing conducted at its subordinate centers. DTC also offers testing services to other DoD military services and federal agencies, state and local governments, foreign and allied governments, and private industry. OTC is headquartered at Fort Hood, Texas, and is responsible for the planning and management of all operational testing in the areas of equipment, doctrine, force design, and training, using typical soldiers to determine system effectiveness, suitability, and survivability.

The Army Evaluation Center (AEC) is headquartered in Alexandria, Virginia, while maintaining locations at APG, Fort Monmouth, New Jersey, and Fort Bliss, Texas. AEC is the Army's total system evaluator who provides to the final decision-makers the documentation on system effectiveness, suitability, and overall performance during testing. AEC's early involvement in the acquisition process and working closely with the PMs and test communities ensures that T&E strategies and objectives are consistent throughout the acquisition program.

The Army Materiel Systems Analysis Activity (AMSAA) is part of the Research, Development, and Engineering Command (RDECOM) and is located at the Aberdeen Proving Ground. AMSAA provides the DoD acquisition and T&E

communities with analysis support and solutions to materiel and logistics systems issues to support the decision-making process for acquiring and fielding new technologies.

The Army Research Laboratory (ARL) is organized under the Research, Development, and Engineering Command (RDECOM), and is headquartered at the Adelphi Laboratory Center in Adelphi, Maryland. ARL provides the Army and other DoD organizations with applied research, analysis, and testing of weapons, materials, human systems integration, computational sciences, and vehicle and equipment survivability and lethality.

The Aberdeen Test Center (ATC) is located at the Aberdeen Proving Ground, 25 miles northeast of Baltimore, Maryland, bordering the Chesapeake Bay. The installation consists of 79,000 acres of water and land mass, and has been operating since January 1918. Today, ATC is the lead DoD test center for automotive (manned and unmanned ground vehicles), large caliber and small arms, direct fire and munitions, and live fire vulnerability and lethality testing.

The Aviation Technical Test Center (ATTC) is located at Cairns Army Airfield, Fort Rucker, Alabama. ATTC is the U.S. Army's flight test activity for airworthiness-qualification of both rotary and fixed-wing aircraft, aviation systems, and aviation support equipment.

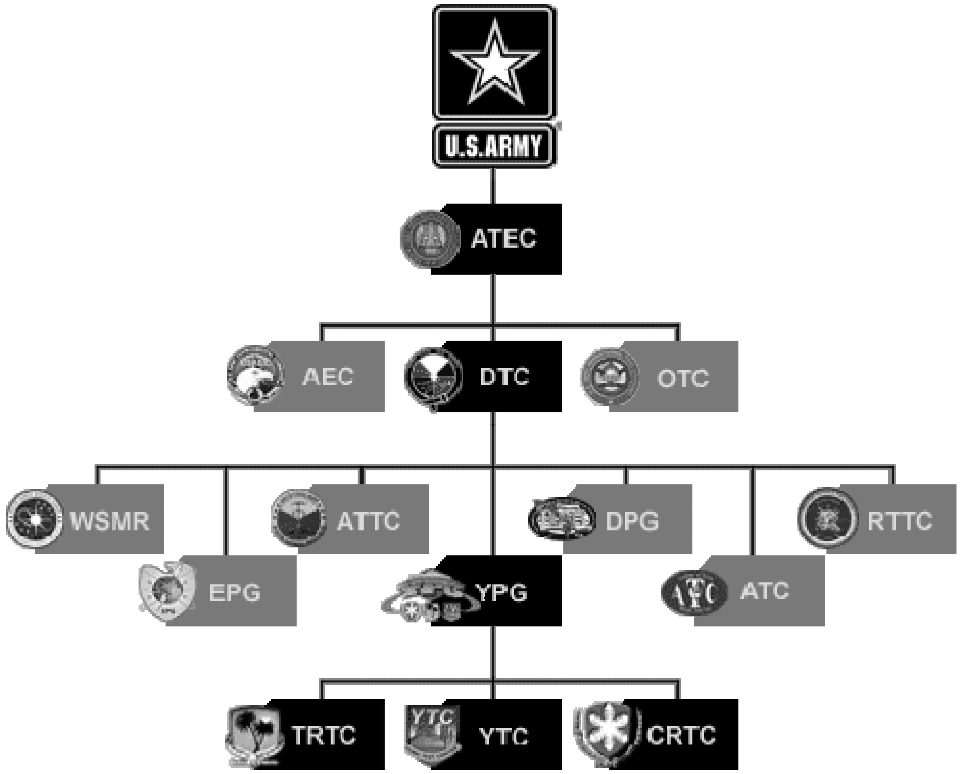

Figure 6. U.S. Army Test and Evaluation Command Organization Chart (From: [14])

Dugway Proving Ground (DPG) is home to the West Desert Test Center (WDTC), and is located 85 miles southwest of Salt Lake City, Utah, in the Great Salt Lake Desert on 798,855 acres of land. WDTC serves as the nation's chemical and biological defense proving ground, and also conducts reliability and survivability testing for meteorological, smoke, obscurants, illumination, and munitions systems.

The Yuma Proving Ground (YPG) and the Yuma Test Center (YTC) is an ATEC test activity located near the Arizona-California border, approximately 24 miles north of the city of Yuma, Arizona. In the context of this JAP, the reference of YPG or YTC is considered to be the same test activity. YTC is a multi-purpose test complex for the Army's desert environment testing, with only about three inches of rainfall per year, encompassing more than 1,300 square miles of test range area and 2000 square miles of restricted airspace. The test center offers realistic testing in air delivery, ground combat systems, aircraft armament, unmanned systems, and automotive commodity areas.

The Redstone Technical Test Center (RTTC) is one of the U.S. Army Test and Evaluation Command (ATEC) activities located on Redstone Arsenal near

Huntsville, Alabama, and encompasses over 14,000 acres of land. RTTC is one of the eight test centers that comprise the Developmental Test Command. RTTC's primary service is to provide advanced testing of weapon systems for the Department of Defense and its contractors. The Center provides advanced testing in two major areas; flight-testing of small rockets and guided missiles and advanced life-cycle testing for weapon subsystems and components.

The Tropic Regions Test Center (TRTC) is located in Hawaii and Panama, while other test facilities are currently being established over a wide geographic area for growing tropical testing requirements. TRTC offers real-world tropical effects that include insects, bacteria, high temperature and humidity conditions, RAM testing of soldier systems, and provides mobility testing to evaluate system ruggedness and small team effectiveness.

The Cold Regions Test Center (CRTC) is located in the mountainous regions of Alaska encompassing over 670,000 acres of land with restricted airspace to unlimited altitude. CRTC accommodates a full range of cold weather or temperate climate tests, including automotive cold start capabilities, mines, explosives, small arms tests, direct fire tests, sensor testing, air defense, missile, artillery, smoke and obscurant tests, and mobility testing. CRTC can accommodate indirect fire testing with the capability of observed fire to 30 km and unobserved fire to 50 km. Indirect fire up to 100 km is accomplished by utilizing ranges near Fort Wainwright, with the impact on Fort Greely areas.

The Army's Electronic Proving Ground (EPG) is located at Fort Huachuca, Arizona, and encompasses 76,000 acres of land. EPG's remote location is an environment free of radio-frequency interference, making it the Army's nucleus for testing Command, Control, Communications, Computer, and Intelligence (C4I) equipment and electronic systems. EPG offers developmental testing of C4I systems, Unmanned Aerial Vehicles (UAVs), and navigation and avionics systems.

The White Sands Missile Range (WSMR) is located 20 miles east of Las Cruces, New Mexico, and is where the United States successfully tested the world's first atomic bomb. WSMR covers 3,200 square miles, which makes it the largest military installation in the country. WSMR offers a variety of services including research and development, military systems and commercial product assessments, environmental testing, computer modeling, and open-air/over-land missile testing.

Fort Indiantown Gap National Guard Training Center (FITG) is located in Annville, Pennsylvania, 23 miles east of Harrisburg, Pennsylvania. FITG is a 17,000 acre National Guard Training site, and offers military and law enforcement training, equipment testing, and accommodates a variety of live-fire ranges, including small arms, shoulder-launched rockets, and anti-armor devices.

b. Navy and Marines T&E Agencies

The Operational Test and Evaluation Force (COMPTEVFOR) is located at the Norfolk Naval Base in Norfolk, Virginia. COMPTEVFOR is the Navy's sole independent test and evaluation activity, reporting directly to the Chief of Naval Operations. Slightly dissimilar to the Army's T&E organizational structure, COMPTEVFOR combines test and evaluation within each division, and structured along flexible lines, which gives primary consideration to the type of warfare and expertise. These areas are the Undersea Warfare Division, Aviation Warfare Division, C4I and Space Division, Surface Warfare Division, and Expeditionary Warfare Division. Unless otherwise specified, the use of COMPTEVFOR in this JAP refers to the Navy evaluation support. Reference to other Navy activities constitutes testing support.

The Marine Corps Operational Test & Evaluation Activity (MCOTEA) is located at Quantico, Virginia, and is the United States Marine Corps (USMC) OT&E authority for all Marine systems and equipment.

The Naval Research Laboratory (NRL) is located in the southwest quadrant of Washington, DC. NRL conducts an extensive multidisciplinary program of technological development, scientific research, and collaborative testing associated with maritime applications including advanced materials, support equipment, atmospheric systems, and space sciences.

The Naval Air Systems Command (NAVAIR) is headquartered at the Patuxent River Naval Base in Patuxent River, Maryland. NAVAIR is one of the Navy's five systems commands and designs, acquires, manages, and maintains the Navy air systems enterprise. The Naval Air Warfare Center Aircraft Division (NAWCAD), also located in Patuxent River, is one of the subordinate organizations of NAVAIR. NAWCAD executes life-cycle support in the areas of engineering development, acquisition, test and evaluation, logistics, and training. In addition, the Fleet Readiness Center East, at the Marine Corps Air Station Cherry Point, North Carolina, is a member of the NAVAIR community, primarily providing the Marine Corps and Navy with aviation maintenance and RDT&E support. Furthermore, Cherry Point supports DoD with logistics management and direct field support for a variety of assignments.

The Naval Sea Systems Command (NAVSEA) is headquartered in Washington, DC, and is the largest of the Navy's systems commands. The NAVSEA and NAVAIR organizations function is a similar way, where NAVSEA is responsible for the Navy's entire fleet and their combat systems. The Naval Surface Warfare Center (NSWC), Dahlgren Division, is located in Dahlgren, Virginia, and is structured under NAVSEA. Dahlgren primarily focuses on research, development, and testing on warfare systems, weapons, munitions, sensors, software, and force protection. Dahlgren also offers drop testing, environmental effects, and electromagnetic energy interference testing and evaluation. The Carderock Division is located in West Bethesda, Maryland, focusing on survivability, structures, and materials. Carderock also specializes in equipment shock hardening, vibration testing, hull design, and shipboard survivability. The Navy Clothing and Textile Research Facility (NCTRF) is a NAVSEA asset for the RDT&E of personal protective equipment, damage control, and fire protection engineering. NCTRF hosts a variety of testing capabilities, including a dynamic fire test chamber, a pressurized steam test chamber, and a thermal oven chamber specifically designed for the testing of PPE. The Navy's Space and Naval Warfare Systems Command (SPAWAR) is located in San Diego, California, and provides DoD with RDT&E and logistical support, acquisition management of joint systems associated with C4I and space technologies.

The Naval Operational Medicine Institute (NOMI) is located in Pensacola, Florida. NOMI participates in doctrine development, experimentation, and testing in support of naval operations and naval survival systems.

The Naval Safety Center (NSC) is located in Norfolk, Virginia, and provides the Secretary of the Navy (SECNAV) with safety-related management for all Naval and Marine Corp issues. NSC also provides the DoD acquisition community with system evaluations, risk identification, and hazard analysis documentation for programs under development.

Naval Station Mayport, Florida, is adjacent to Jacksonville and situated on 3,400 acres of land. Mayport provides naval fleet port accommodations, operational and training activities for anti-submarine warfare, and also provides on-board operational testing and training support through the Afloat Training Group (ATG).

The Marine Corps Systems Command (MARCORSYSCOM), headquartered at Marine Base Quantico, Virginia, and the home of Marine training and doctrine since 1917. MARCORSYSCOM is the principal activity for acquisition, testing, and sustainment of systems and equipment used by the Marine forces. MARCORSYSCOM products encompass the full spectrum of warfighter needs, including armor, combat and support, C4I, ground transportation, and sensor systems.

c. Air Force T&E Agencies

The Air Force Operational Testing and Evaluation Command (AFOTEC) is headquartered at Kirtland Air Force Base (AFB), New Mexico, which is also the site to one of five Air Force T&E detachments; Eglin AFB-Florida, Peterson AFB-Colorado, Edwards AFB-California, and Nellis AFB-Nevada. AFOTEC provides multi-service test and evaluation support in the areas of weapons, support equipment, C4ISR, space, missile defense, and aircraft.

The Air Force Medical Operations Agency (AFMOA) is located at Brooks Air Force Base, San Antonio, Texas. AFMOA is responsible for the Air Force's aerospace medicine, bioenvironmental engineering and bioenvironmental, and is the consultant lead for aerospace medicine and preventive medicine, clinical research, medical resources, and chemical, biological, and radiation protection.

Edwards Air Force Base, California, is home to the Air Force Flight Test Center (AFFTC). AFFTC conducts flight and ground testing of aircraft and support equipment, weapons systems, software, and additionally performs Modeling and Simulation (M&S) for the Air Force.

Wright-Patterson Air Force Base (WPAFB), Ohio, is home to the Air Force Materiel Command (AFMC) conducting RDT&E, acquisition management, and logistical operations for Air Force systems. WPAFB is also home to the Air Force Research Laboratory (AFRL), Aeronautical Systems Center, and National Museum of the United States Air Force.

Prior to its closure in 2001, McClellan Air Force Base in Sacramento, California, was home to the Sacramento Air Logistics Center, situated on 3,778 acres of land, and conducts a variety of missions including the maintenance and management of US Air Force electrical components, communications, electronics systems, fluid drive accessories, and tactical shelters.

Hill Air Force Base is located in northern Utah, operating and maintaining the Utah Test and Training Range. The range provides open air testing services for a variety of needs, including weapons testing, large force training exercises, and range support for Air Force operational test and training programs.

The Air Mobility Command at Pope Air Force Base, North Carolina, is responsible for delivering humanitarian effects and expeditionary aid, aerial refueling, and aerial combat support. Additionally, Pope AFB groups provide support aircraft to training exercises and operational testing.

d. The Commercial Sector

Wyle Laboratories Inc. is headquartered in El Segundo, California, with more than 30 facilities nationwide. Wyle labs provide test and evaluation support to DoD, NASA, and commercial customers with vibration systems testing, environmental, and structural testing. Wyle also provides support in acquisition management, engineering, and space sciences.

Alion Science & Technology R&B Laboratory operates as an independent testing lab for electro-magnetic emission and interference, and radio frequency quantification supporting the automotive industry, various commercial aircraft and avionics products, and military applications.

Battelle is a large international science and technology business, headquartered in Columbus, Ohio, possessing RDT&E capabilities in energy conservation, lab management, heath sciences, and national security and defense. Additionally, Battelle supports defense projects associated with chemical and biological detection and protection equipment for the joint services.

Lincoln Laboratory at the Massachusetts Institute of Technology (MIT) is a federally funded R&D center for applied science and technology, specializing in advanced electronics applications associated with air and missile defense, communications, tactical and space surveillance, and air traffic control systems.

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III. DATA SUMMARY

A. INTRODUCTION

The researcher's approach to data collection is to gather information for the purposes of both elimination and discovery. This approach is based upon a philosophy that there are no erroneous samples of data. The many significant discoveries that have been made by exploiting seemingly useless data for other purposes, supports this mindset. The tester's approach to data collection is more narrowly focused; to validate a known or desired parameter through measurement.

Data was collected for this research project using the philosophy of a researcher, with the constraint that each data element must be applicable to multiple programs. This constraint minimized the collection and presentation of data that had no possibility of helping to answer the primary and secondary research questions. The data presented in this chapter was collected from twenty-three acquisition programs. These programs cover the breadth and depth of acquisition possibilities, including, ACAT I, II, and III; T&E oversight and non-oversight; joint service and Army-only; CBDP and non-CBDP; Milestone B through Full Rate Production; and both current and legacy acquisition programs.

The majority of the data contained in this chapter is directly traceable to data elements extracted from the twenty-three program TEMPs recorded in the List of References. Other documents, such as the program's performance specification were used to fill TEMP data gaps when possible. The one derived category of data element presented in this chapter is the quantifiable data for CTPs and MOE-MOS. The derivation method for the quantifiable data types is defined in Chapter IV.

The data presented in this chapter is categorized as, principal data; secondary data; and unavailable, inconsistent, and/or deficient data. Principal data is the primary information source for analysis in Chapter IV. Secondary data only indirectly supports answers to the research questions, while the last category of data encompasses information that either was not available or could not be effectively analyzed.

B. DATA PARAMETERS

1. Principal Data

Principal data is defined as tangible and consistently available information associated with each program. This information provides administrative and technical details for PM planning and estimating purposes, and is equally valuable for strategic T&E preparation.

Programmatic and Technical data consists of Critical Technical Parameters, Measures of Effectiveness, and Measures of Suitability. CTPs describe system hardware and software characteristics and thresholds contained in the CDD, and must be consistent with system operational performance requirements. Critical technical parameters are,

> measurable critical system characteristics that, when achieved, allow the attainment of desired operational performance capabilities. They are not user requirements. Rather, they are technical measures derived from desired user capabilities. Failure to achieve a critical technical parameter should be considered a reliable indicator that the system is behind in the planned development schedule or will likely not achieve an operational requirement. [15, p. 9.10]

Table 1 presents the total number of CTPs and quantifiable CTPs for each program.

MOEs are assessments of operational performance that evaluate the degree of successfulness of the system with respect to the objective of the mission or operation. [2, p. B-11] Specifically, the MOE assesses the mission accomplishment of a system when used by representative personnel in the environment planned or expected (e.g., natural, electronic, threat etc.) for operational employment of the system considering organization, doctrine, tactics, survivability, vulnerability, and threat. [15, p. 9.10] A MOS is an operational assessment that evaluates a system's capacity of being satisfactorily fielded in an environment considering issues pertaining to reliability, availability, maintainability, logistical support, compatibility, interoperability, training, human factors, safety, documentation, transportability, wartime usage rates, manning requirements, and natural and environmental effects and impacts. [15, p. 9.10] Table 2 of this chapter presents MOE, MOS, and quantifiable MOE/MOS data sets. The Defense

Acquisition Guidebook suggests that program managers must develop a crosswalk for operational effectiveness and suitability parameters and constraints

> to those used in the Analysis of Alternatives (AoA), and include manpower, personnel, training, software, computer resources, transportation (lift), compatibility, interoperability and integration, Information Assurance (IA), Electromagnetic Environmental Effects, and Spectrum Supportability. The focus is on operational capabilities, not design specifications such as weight and size. [15, p. 9.10]

Although seemingly trivial, the TEMP page count, Table 3, is essentially the total number of pages, excluding the cover and signature pages, and the number of pages in sections I through V. Surprisingly, this information gives useful insight into which programs followed the DoD recommended TEMP page count guidelines and formulates insight into the level of documentation effort.

Many DoD acquisition programs utilize numerous organizations for T&E support depending upon system requirements, organizational past performance, and range availability, to name a few. The programs investigated in this JAP benefited from the diverse expertise of multi-service and private testing organizations briefly introduced in Chapter II, consisting of the Army, Navy, and Air Force testing and evaluation commands, in addition to a host of industry and university locations, such as Lincoln Labs at MIT. Tables 5 through 12 illustrate the various test and evaluation organizations utilized by each program.

2. Secondary Data

Selected programmatic and service-specific information concerning each program was collected for reference and to help bridge gaps in formulating an enhanced comprehensive analysis. This section consists of the total number of estimated personnel required throughout DT and OT, COIs, the TEMP date, and program oversight requirements.

The TEMP date, shown in Table 4, is the official date of document authorization and/or the current documented revision. Each program's TEMP date was collected for comparative purposes in an attempt to discover a relationship of pre/post-year 2000 TEMPs to other principal and secondary data.

All ACAT I, and selected ACAT II programs, require OSD and DOT&E oversight as described in the Background Chapter. However, many ACAT III programs are not burdened with this acute, yet necessary supervision. Three of the seventeen ACAT III programs investigated required some level of oversight. Interestingly, these three programs are detection systems.

Critical Operational Issues are the key operational effectiveness or suitability issues that must be scrutinized during OT&E to determine a system's capability of successfully executing the intended mission. COIs are typically represented as questions. The total number of COIs for each program are listed in Table 2. The number of COIs demonstrated no stand-alone significance. However, the development of a mathematical analysis of effectiveness and suitability issues enabled a direct comparison of programs across ACAT levels and is investigated in Chapter IV.

3. Unavailable, Inconsistent, and/or Deficient Data

Certain program data was initially perceived as indisputable evidence supporting the questions in this JAP. The most difficult and disappointing sets of data was program funding. The original methodology was to focus all other supporting data with the amount of funding each program received and determine if the smaller programs typically endured the same T&E burden while having less funding and resources. It was discovered that the funding requirements estimated in the TEMPs only reported combined RDT&E funding. A valid funding comparison was not possible due to the drastic differences in system complexity and varying production quantities. High complexity programs with less technical maturity will likely have more research funding. This budgeting information must be a separate line item of the total RDT&E estimate in order to accurately determine the T&E segment. Additionally, the RDT&E funding reported in the Program Objective Memorandum (POM) drastically differed from the data gathered from TEMPs. For example, POM funding data includes congressional plus-ups and reductions, program re-structuring, and out of control cost increases, rendering a sensible comparison virtually unattainable. Additionally, the TEMP funding data were skewed based upon the various acquisition phases.

Another data set expelled from the analysis was the total number of required personnel estimated throughout testing due to incompleteness and inconsistencies across the programs. Some TEMPs were exceedingly specific, listing the various multi-service requirements, logistical support personnel, the number of evaluators, etc. Some TEMPs explicitly called for precise numbers of officers and enlisted personnel by their actual Military Occupational Specialty (MOS), the number of battalions, companies, teams, shipboard and Operational Force (OPFOR) participants during specific events. Other programs were exceedingly broad in their requirements, merely mentioning the need for test support personnel and OT participants.

Likewise, an impartial comparison of the number of test articles and supporting equipment estimated in the program TEMP's emerged from the data set. It is not practical to compare a program requiring nine vehicles to a chemical detection system's requirement of 250 detectors, or even 5,750 masks for a mask program. Additionally, some programs were very specific in listing supporting equipment necessary during testing. For example, the Joint Service General Purpose Mask (JSGPM) program required a video reduction station, one portable weather station, two thousand vision correction systems, various video and audio components, and twenty mask leakage testers. In contrast, the Joint Chemical Agent Detector (JCAD) program required numerous vehicles, including sixteen High Mobility Multipurpose Wheeled Vehicles (HMMWVs), three Bradley Fighting Vehicles (BFV), six utility vehicles, and six ten-passenger vans. The JCAD TEMP merely mentioned the need for 35 handheld radios and two Single-Channel Ground-Air Radio System (SINGARS) radio sets. This disparity in requirements was consistently evident across the entire set of TEMP documents and did not demonstrate the continuity required for the analysis in Chapter IV.

The TEMP milestone, shown in Table 4, is the major milestone at which the program achieved authorization, or the current published document version. Knowing the acquisition phase at TEMP currency is fundamentally significant for demonstrating the breadth of data sets across numerous acquisition phases, dissimilar program types, and different ACAT levels.

One effective method for comparing test burden is by associating the number of test events conducted or proposed in the program's Event Design Plan (EDP) to another test parameter. However, the representative data on Army-led test events are available only through ATEC, via the ATEC Decision Support System (ADSS) website. Test event plans and results collected from ADSS do not thoroughly represent the actual total number of events since many programs utilized other services and private laboratories for T&E support, and these organizations were not enthusiastic in providing this type of program information.

Originated in the CDD, previously called the Operational Requirements Document (ORD), Key Performance Parameters are a system's minimum set of user-defined, functional and operational requirements necessary to fulfill the conditions and constraints stated in the Mission Needs Statement (MNS), and pilots the efforts of the System Development and Demonstration Phase. These KPPs must be approved prior to entrance into the SDD Phase, and "may be refined, with the approval of the requirements authority, as conditions warrant." [15, p. 3.7.2.3] KPPs are a critical subset of the performance parameters, are included in the performance portion of the APB, and represent the most significant capabilities or characteristics for a given system. Failure to meet the minimum or threshold value of performance can be cause for program to be reevaluated or terminated. The total number of KPPs for each program is listed in Table 1.

C. HAPTER SUMMARY

The primary focus of this chapter was to define, present, and initially investigate all of the collected data, and determine whether principal and secondary data is beneficial to the development of a mathematical approach, or basis for elimination in the data analysis for answering the questions presented in this JAP. Furthermore, selected programmatic and service-specific information concerning each program were collected for reference and to help bridge gaps in formulating an enhanced comprehensive analysis.

Moreover, the elementary process of organizing the data into practical categories exposed inconsistencies and inadequacies, such as funding, test expendables, special equipment, and manpower estimates that were especially difficult comparisons and provided little insight to the objectives herein.

		DATA PARAMETER		
		TOTAL NO. KPP	TOTAL NO. CTP	TOTAL NO. QUANTIFIABLE CTP
ACAT	**PROGRAM**			
I	**FCS**	7	13	6
	NBCRV	2	25	16
	STRYKER	5	19	11
II	**JBPDS**	5	14	6
	JCAD	0	14	11
	JSLNBCRS	0	22	9
III	**ACADA**	0	17	13
	ALSI-1	4	4	3
	BIDS	4	18	6
	CBPSS	6	24	10
	FOX	0	9	7
	JBAIDS	3	7	5
	JBSDS	4	21	14
	JPACE	2	20	10
	JSGPM	5	41	16
	JSLIST-GLOVE	8	27	16
	JSLSCAD	6	29	21
	JSTDS	5	61	30
	LVOSS	0	11	4
	M45	0	18	15
	M56	0	12	12
	M6	0	7	3
	SHIPBRD-CPS	0	11	9

Table 1. KPPs and Quantifiable CTPs.

		DATA PARAMETER	
		TOTAL NO. MOE/MOS	TOTAL NO. QUANTIFIABLE MOE/MOS
ACAT	PROGRAM		
I	FCS	35	1
	NBCRV	38	5
	STRYKER	24	6
II	JBPDS	29	8
	JCAD	69	34
	JSLNBCRS	19	4
III	ACADA	39	26
	ALSI-1	5	3
	BIDS	12	6
	CBPSS	14	7
	FOX	15	12
	JBAIDS	15	10
	JBSDS	12	6
	JPACE	44	14
	JSGPM	55	16
	JSLIST-GLOVE	25	13
	JSLSCAD	17	11
	JSTDS	51	19
	LVOSS	21	8
	M45	13	8
	M56	27	10
	M6	27	10
	SHIPBRD-CPS	6	5

Table 2. Total Number of MOEs and MOSs.

		DATA PARAMETER			
		NO. COI	NO. TEST ARTICLES	NO. TEMP PAGES	NO. TEMP PAGES SEC. I-V
ACAT	**PROGRAM**				
I	**FCS**	6	NA	482	93
	NBCRV	13	9	78	58
	STRYKER	9	NA	134	57
II	**JBPDS**	4	102	136	67
	JCAD	2	250	160	95
	JSLNBCRS	3	25	74	62
III	**ACADA**	3	140	54	25
	ALSI-1	4	9	71	30
	BIDS	3	12	44	37
	CBPSS	5	18	67	43
	FOX	3	23	30	29
	JBAIDS	2	20	110	70
	JBSDS	3	14	108	40
	JPACE	4	390	102	75
	JSGPM	3	5750	84	46
	JSLIST-GLOVE	3	678	105	51
	JSLSCAD	4	29	76	42
	JSTDS	3	250	83	61
	LVOSS	2	1772	20	16
	M45	4	800	41	35
	M56	2	18	25	17
	M6	2	127	23	18
	SHIPBRD-CPS	2	4	27	23

Table 3. COIs and TEMP Page Counts.

		DATA PARAMETER			
		TOTAL MANPOWER	TEMP DATE	TEMP MILESTONE	OSD/DOT&E OVERSIGHT
ACAT	**PROGRAM**				
I	**FCS**	NA	25-Apr-2003	MSB	YES
	NBCRV	NA	3-Sep-2004	LRIP	YES
	STRYKER	NA	2-May-2003	LRIP	YES
II	**JBPDS**	485	15-Jun-2005		YES
	JCAD	NA	1-Sep-2005	MSIII	YES
	JSLNBCRS	238	23-May-2003	LRIP	YES
III	**ACADA**	NA	9-Dec-1997	FRP	NO
	ALSI-1	NA	30-Oct-2006	SI-IPR/C	NO
	BIDS	NA	12-Sep-2001		NO
	CBPSS	NA	7-Jun-2002		NO
	FOX	NA	Apr-1998		NO
	JBAIDS	34	4-Aug-2006		YES
	JBSDS	90	28-Apr-2004	C	YES
	JPACE	174	11-Mar-2005		NO
	JSGPM	984	10-May-2004	C	NO
	JSLIST-GLOVE	334	30-Mar-2005		NO
	JSLSCAD	90	3-Feb-2006	FRP	YES
	JSTDS	NA	28-Feb-2005		NO
	LVOSS	NA	Oct-1998		NO
	M45	NA	Feb-1994		NO
	M56	NA	Jul-2005		NO
	M6	NA	Sept-2000		NO
	SHIPBRD-CPS	269	23-Mar-1994		NO

Table 4. TEMP Data and Oversight Requirements.

ACAT	PROGRAM	EVALUATION ORGANIZATIONS				
		AEC	AMSAA	COMOPTEVFOR	AFOTEC	MCOTEA
I	FCS	X				
	NBCRV	X				
	STRYKER	X				
II	JBPDS	X				
	JCAD	X		X		
	JSLNBCRS	X				
III	ACADA	X				
	ALSI-1	X				
	BIDS	X				
	CBPSS	X				
	FOX	X				
	JBAIDS				X	X
	JBSDS	X			X	
	JPACE			X	X	X
	JSGPM	X			X	X
	JSLIST-GLOVE	X			X	X
	JSLSCAD	X				
	JSTDS	X		X	X	X
	LVOSS	X				
	M45	X	X			
	M56	X				
	M6	X				
	SHIPBRD-CPS			X		

Table 5. Evaluation Organizations Utilized.

ACAT	PROGRAM	ARMY TESTING ORGANIZATION							
		ATC	DTC	DPG	EPG	YPG	WSMR	CRTC	ARL
I	FCS	X	X	X	X	X	X	X	X
	NBCRV	X		X	X	X	X	X	X
	STRYKER	X	X	X	X	X	X	X	
II	JBPDS	X		X			X		
	JCAD	X	X	X		X	X	X	
	JSLNBCRS	X		X	X	X	X		
III	ACADA	X			X	X	X	X	
	ALSI-1	X		X	X	X	X		
	BIDS	X	X	X			X		
	CBPSS	X	X			X	X		
	FOX	X		X			X		
	JBAIDS		X	X					
	JBSDS	X		X			X		
	JPACE		X						
	JSGPM	X	X	X		X	X	X	
	JSLIST-GLOVE	X	X	X					
	JSLSCAD	X	X	X		X	X		
	JSTDS	X		X			X		
	LVOSS	X		X	X	X	X	X	
	M45			X		X		X	X
	M56	X		X		X	X	X	
	M6	X		X		X	X	X	
	SHIPBRD-CPS								

Table 6. Army Test Organizations Utilized.

ACAT	PROGRAM	ARMY TESTING ORGANIZATION						
		ECBC	RTTC	TRTC	Ft DRUM	OTC	FITG	Ft. Huachuca
I	FCS	X		X				
	NBCRV			X				
	STRYKER			X		X		
II	JBPDS							
	JCAD	X		X				X
	JSLNBCRS							
III	ACADA	X		X				
	ALSI-1	X						
	BIDS	X						
	CBPSS	X			X	X	X	
	FOX	X						
	JBAIDS							
	JBSDS							
	JPACE	X						
	JSGPM	X		X				
	JSLIST-GLOVE							
	JSLSCAD							
	JSTDS	X						
	LVOSS	X	X	X				
	M45	X		X		X		
	M56	X		X				
	M6	X	X	X				
	SHIPBRD-CPS							

Table 7. Additional Army Test Organizations.

ACAT	PROGRAM	NAVY TESTING ORGANIZATION						
		NRL	NAVSEA	NAVAIR	NSWC	Norfolk	Quantico	Mayport
I	FCS							
	NBCRV							
	STRYKER							
II	JBPDS		X					X
	JCAD			X	X	X	X	
	JSLNBCRS							
III	ACADA							
	ALSI-1							
	BIDS							
	CBPSS							
	FOX							
	JBAIDS							
	JBSDS							
	JPACE			X				
	JSGPM							
	JSLIST-GLOVE							
	JSLSCAD							
	JSTDS							
	LVOSS							
	M45							
	M56	X						
	M6							
	SHIPBRD-CPS							

Table 8. Navy Test Organizations Utilized.

ACAT	PROGRAM	NAVY TESTING ORGANIZATION				
		NOMI	NCTRF	NSC	NAWCAD	SPAWAR
I	FCS					
	NBCRV					
	STRYKER					
II	JBPDS					
	JCAD					
	JSLNBCRS					
III	ACADA					
	ALSI-1					
	BIDS					
	CBPSS					X
	FOX					
	JBAIDS					
	JBSDS					
	JPACE	X	X	X	X	
	JSGPM					
	JSLIST-GLOVE					
	JSLSCAD					
	JSTDS					
	LVOSS					
	M45					
	M56					
	M6					
	SHIPBRD-CPS					

Table 9. Additional Navy Test Organizations.

ACAT	PROGRAM	AIR FORCE TESTING ORGANIZATION					
		McLellen	Englin	Dahlgren	AFFTC	Pope	Hill
I	FCS						
	NBCRV						
	STRYKER						
II	JBPDS	X	X				
	JCAD			X	X	X	X
	JSLNBCRS						
III	ACADA						
	ALSI-1						
	BIDS						
	CBPSS			X			
	FOX		X				
	JBAIDS		X				
	JBSDS						
	JPACE		X				
	JSGPM		X				
	JSLIST-GLOVE			X			
	JSLSCAD						
	JSTDS	X					
	LVOSS		X				
	M45						
	M56						
	M6						
	SHIPBRD-CPS						

Table 10. Air Force Test Organizations.

ACAT	PROGRAM	AIR FORCE TESTING ORGANIZATION			
		Martin Electronics	WPAFB	Cherry Point	AFMSA
I	FCS				
	NBCRV				
	STRYKER				
II	JBPDS				
	JCAD				
	JSLNBCRS				
III	ACADA				
	ALSI-1				
	BIDS				
	CBPSS				
	FOX				
	JBAIDS				X
	JBSDS				
	JPACE				
	JSGPM				
	JSLIST-GLOVE		X	X	
	JSLSCAD				
	JSTDS				
	LVOSS				
	M45				
	M56				
	M6	X			
	SHIPBRD-CPS				

Table 11. Additional Air Force Test Organizations.

ACAT	PROGRAM	PRIVATE TESTING ORGANIZATIONS			
		Alion Labs	Battelle	Lincoln Labs/MIT	Whyle Labs
I	FCS				
	NBCRV				
	STRYKER				
II	JBPDS	X	X	X	X
	JCAD				
	JSLNBCRS				X
III	ACADA				
	ALSI-1				
	BIDS				
	CBPSS				
	FOX				
	JBAIDS				
	JBSDS				
	JPACE		X		
	JSGPM				
	JSLIST-GLOVE		X		
	JSLSCAD				
	JSTDS		X		
	LVOSS				
	M45				
	M56				
	M6		X		X
	SHIPBRD-CPS				

Table 12. Private Test Organizations Utilized.

IV. DATA ANALYSIS

A. INTRODUCTION

This chapter analyzes the data presented in Chapter III to develop answers to the primary and secondary research questions. The primary research question is, "Is the Test and Evaluation (T&E) Level of Effort (LoE) proportional to the ACAT level?" The secondary questions are "How does program oversight by the Director, Operational Test and Evaluation or the Army drive the T&E LoE?" and "Are Chemical/Biological (C/B) programs a special case for T&E LoE?"

The analysis is presented in three parts, data scope and limitations, analysis approach, and data analysis. Understanding the limitations and scope of the data set is critical to the development of a defendable analysis approach and to accurate interpretation of the results obtained. Similarly, the analysis must be performed within the context of the data set and the results obtained qualified based upon the data and analysis limitations. The analysis presented in this section is framed to ensure that the context of the baseline data is maintained.

B. LIMITATIONS AND SCOPE

The principal data source for this effort was the TEMP for each program. Other program documents, including performance specifications, OSD budget and program oversight data, Single Acquisition Management Plan (SAMPs), APBs, and requirements documents were used to fill TEMP data gaps and to help answer the secondary research questions.

During data collection efforts, it became clear that the variability in the level of detail and the types of information included in CBD TEMPs would also limit the scope of this analysis effort. Although these TEMPs generally included an Integrated Program Summary (IPS) and cost data, the level of detail and consistency of data program-to-program did not support a comparative analysis of test schedules or of program R&D, test, and production costs. A comparison of program schedules and budgets, taken from the OSD(C) website, also did not generate data sufficient to perform a test costs comparison of CBD programs. This lack of test-specific data re-scoped the analysis to the technical and operational requirements and testing listed in each TEMP and to the documentation scope of each TEMP.

Another limitation of the analysis effort was the difficulty in gaining access to non-CBD TEMPs. The team was only able to obtain copies of TEMPs for two Army programs outside of the CBDP, Stryker and Future Combat Systems (FCS). Both of these programs are ACAT I-D. Therefore, analysis in support of the secondary research question, "Are Chemical/Biological programs a special case for T&E LoE?" is constrained by this limited data set.

C. APPROACH

The answer to the primary research question was developed through an analysis of the system requirements, documentation scope, and test scope. The secondary research questions were answered by further dividing the existing data into smaller subsets, based on oversight and CBD program status.

1. System Requirements

The initial approach to data analysis was to perform a comparison of the system-level requirements in each TEMP to the scope of the resultant testing, sorted by ACAT. Requirements were sorted into two main categories, Operational Effectiveness (OE), and Operational Suitability (OS). Each requirement was further categorized to a functional area (e.g., operation, interoperability, environmental, mobility, primary technical performance characteristic (such as detection), and logistics). This analysis approach allowed a comparison of detection systems, but broke down for other types of CBD programs, such as vehicles, shelters, and individual protection due to the lack of consistent requirement categorization and detail levels in TEMPs from different functional areas.

A mathematical approach was developed to normalize data across TEMPs after it was determined that direct comparisons of OE and OS would not be possible. The change to a mathematical analysis enabled a direct comparison of programs without the need for a requirement-to-requirement crosswalk. This requirements analysis technique is based on calculation of a program-specific quantified requirements ratio using the MOE, MOS, and CTPs, followed by an ACAT-based summarization. A similar ratio was also calculated for COIs. The analysis results were then reviewed to determine what, if any, ACAT-specific trends were apparent.

2. Documentation Scope

Per DA Pamphlet 73-1, "the target size of a TEMP should be approximately 30 pages, including pages for figures, tables, matrices, and so forth. Although annexes and attachments are excluded from the 30-page limit, their size should be kept to a minimum." [11, p. 15] Likewise, the Navy's Operational Test Director's Guide suggests, "a TEMP is generally limited to 30 pages." [16, p. 5-3] Since the Army and Navy provides explicit guidance for TEMP page counts, the documentation scope analysis consists of tallying the sections I – V and total page counts for the TEMPS, then comparing the averages for each ACAT. Secondarily, the effects of test program oversight and a time-based analysis of the scope of ACAT III TEMPs will be investigated.

3. Test Scope

The scope of testing involves many factors; including test sites used, types of tests, funding used, and time and manpower required for testing. The analysis of test scope will focus on the involvement of test conduct and evaluation organizations and the types of tests each program listed (e.g., MIL-STD-810 environmental tests) to determine whether there are any ACAT level biases to test scope.

D. DATA ANALYSIS

1. System Requirements

It was noticed during data collection that some of the requirements in each TEMP were more technically-focused, or quantifiable, than others. The quantifiable versus non-quantifiable nature of each requirement was captured as a secondary characteristic of the data.

The simple set of questions developed to categorize whether a requirement is quantifiable are,

- Can a determination of whether the system meets the requirement be made by simple observation or as an observable byproduct of a test for another characteristic? If so, the requirement is not quantifiable.
- Does determination of whether the system meets the requirement require a formal nontrivial test? If so, the requirement is quantifiable.
- Does the requirement include performance parameters that only require a yes/no or go/no-go answer? If so, the requirement is not quantifiable.

Typical formats for quantifiable requirements are,

- MOE, Probability of Detection (Pd) = 92% for point concentration
- MOE, Accomplish OMS/MP following a HEMP event
- MOS, MTBFA ≥ 246 hr
- MOS, Minimum of 1000 mean miles between critical vehicle failures
- CTP, Collective pressure system with 2.5 IWG overpressure at 90 CFM
- CTP, Meets EMI requirements of MIL-STD-461, test RS103

Non-quantifiable requirements are more general in nature, such as,

- MOE, Able to be powered by rechargeable and non-rechargeable batteries
- MOE, Shall be worn inside combat footwear
- MOS, Includes a confidence checker
- MOS, Crew size of not more than 4 crew members
- CTP, HMMWV and M113 mounted ability
- CTP, Equipped with run-flat tires

The total quantifiable requirements per TEMP are listed in Table 1 for CTPs and in Table 2, for the combination of MOE and MOS. Two factors contributed to the merging of MOE with MOS in the analysis (where MOS includes suitability and survivability); the lack of discrimination between MOE and MOS within many of the TEMPs and the operational focus of both requirements when compared to the technically oriented CTPs.

Determination of whether a requirement was quantifiable or non-quantifiable neither directly allowed a meaningful comparison of programs, nor did it provide insight into any ACAT-specific relationships. Since the number of quantifiable and total requirements in the form of MOE, MOS, and CTPs varied widely over the twenty three programs analyzed, a straightforward comparison based upon numbers of requirements did not yield any useful relationships. A comparison of individual requirements did not prove feasible, also due to the varied nature of system-specific requirements, even within the CBDP.

Only with the development of a program-specific ratio of quantifiable to total requirements, was it possible to compare programs in an analytical manner. The ratio developed is called the CTP/MOE-MOS ratio, or more succinctly the C/M-M ratio.

Calculation of the C/M-M ratio requires the preliminary calculation of the quantifiable MOE and MOS ratio, and the calculation of the quantifiable CTP ratio. Once these values are defined, the C/M-M ratio is calculated by dividing the quantifiable CTP ratio by the quantifiable MOE and MOS ratio. The formula is,

$$\text{C/M-M Ratio} = \frac{\text{Quantifiable CTP Ratio}}{\text{Quantifiable MOE-MOS Ratio}}$$

where,

$$\text{Quantifiable CTP Ratio} = \frac{\text{Number of Quantifiable CTPs}}{\text{Total Number of CTPs}}$$

$$\text{Quantifiable MOE-MOS Ratio} = \frac{\text{Quantifiable MOE+MOS}}{\text{Total Number of MOE+MOS}}$$

The program-specific C/M-M ratios are listed in Table 13, Calculated System Requirements Ratios, and graphed in Figure 7, Quantified C/M-M Ratio for All Programs. Table 13 also includes a COI-based ratio, which is defined as the number of COIs divided by the C/M-M ratio. The formula for the COI/C/M-M ratio is,

$$\text{COI/C/M-M Ratio} = \frac{\text{Number of COIs}}{\text{C/M-M Ratio}}$$

ACAT	PROGRAM	Program System Requirements Ratios			
		Percent Quantifiable MOE/MOS	Percent Quantifiable CTPs	C/M-M Ratio	COI/ C/M-M Ratio
I	FCS	2.9	46.2	16.2	0.37
	NBCRV	13.2	64.0	4.9	2.67
	STRYKER	25.0	57.9	2.3	3.89
II	JBPDS	27.6	42.9	1.6	2.57
	JCAD	49.3	78.6	1.6	1.88
	JSLNBCRS	21.1	40.9	1.9	1.54
III	ACADA	74.3	76.5	1.0	2.91
	ALSI-1	60.0	75.0	1.3	3.20
	BIDS	50.0	33.3	0.7	4.50
	CBPSS	50.0	41.7	0.8	6.00
	FOX	80.0	77.8	1.0	3.09
	JBAIDS	66.7	71.4	1.1	1.87
	JBSDS	50.0	66.7	1.3	2.25
	JPACE	31.8	50.0	1.6	2.55
	JSGPM	29.1	39.0	1.3	2.24
	JSLIST-GLOVE	52.0	59.3	1.1	2.63
	JSLSCAD	64.7	72.4	1.1	3.57
	JSTDS	37.3	49.2	1.3	2.27
	LVOSS	38.1	36.4	1.0	2.10
	M45	61.5	83.3	1.4	2.95
	M56	37.0	100.0	2.7	0.74
	M6	37.0	42.9	1.2	1.73
	SHIPBRD-CPS	83.3	81.8	1.0	2.04

Table 13. Program-Level System Requirements Ratios

Both ratios were developed to provide a measure of the technical orientation of the operational requirements for a system. These ratios also introduce a level of abstraction to the analysis, which proved essential to performing meaningful comparisons of systems at the ACAT level.

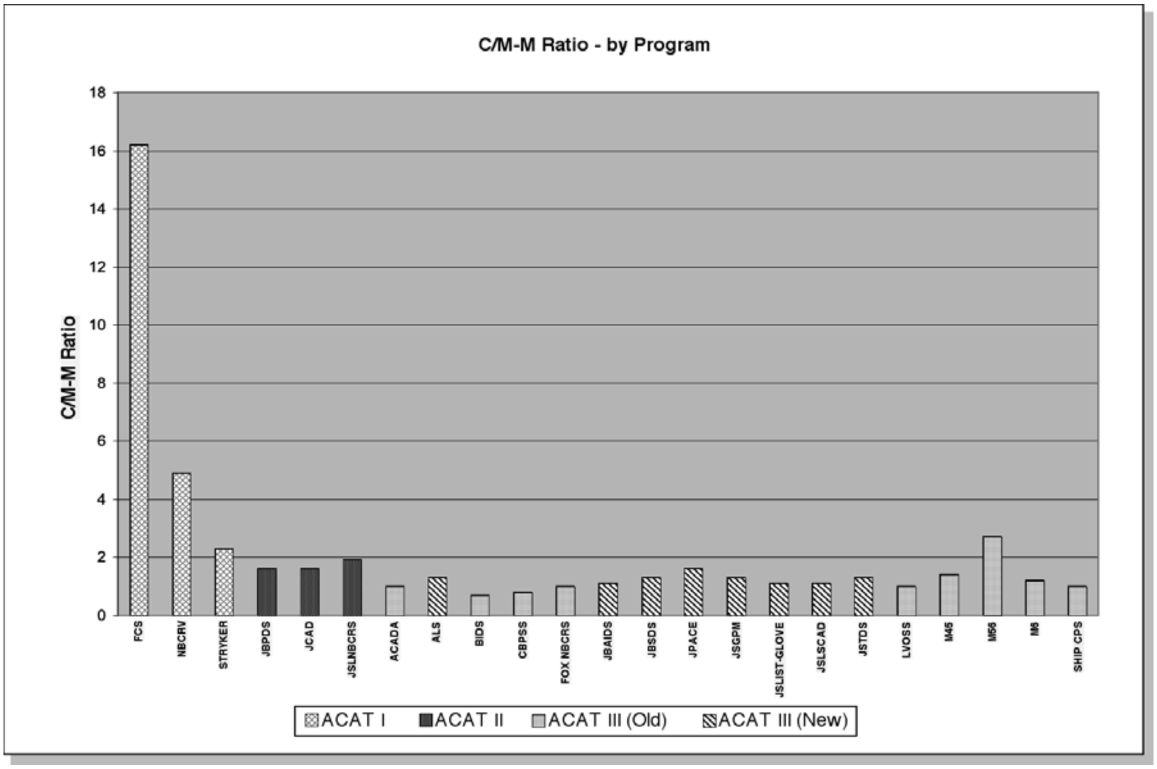

Figure 7. Quantified C/M-M Ratio for All Programs

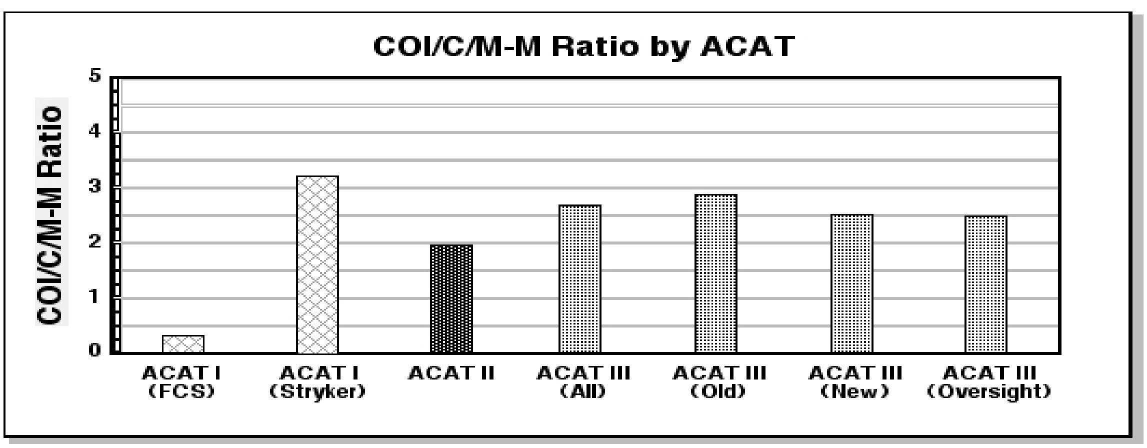

Figure 8. COI/C/M-M Ratios by ACAT

ACAT	Systems Requirements Ratio Summary					
	Mean C/M-M Ratio	Standard Deviation of C/M-M Ratio	Mean + Standard Deviation	Mean – Standard Deviation	Standard Deviation as a Percent of C/M-M Ratio Mean	Mean COI/ C/M-M Ratio
I (All)	7.78	7.36	15.14	0.41	94.7	2.31
I (Stryker)	3.59	1.80	5.39	1.79	50.2	3.28
II	1.70	0.21	1.91	1.48	12.6	2.00
III (All)	1.22	0.44	1.66	0.78	35.9	2.74
III (Old)	1.18	0.63	1.81	0.55	53.3	2.90
III (New)	1.26	0.26	1.53	1.00	20.9	2.57
III (Over-sight)	1.17	0.14	1.31	1.04	11.9	2.56

Table 14. System Requirements Ratio Summary by ACAT

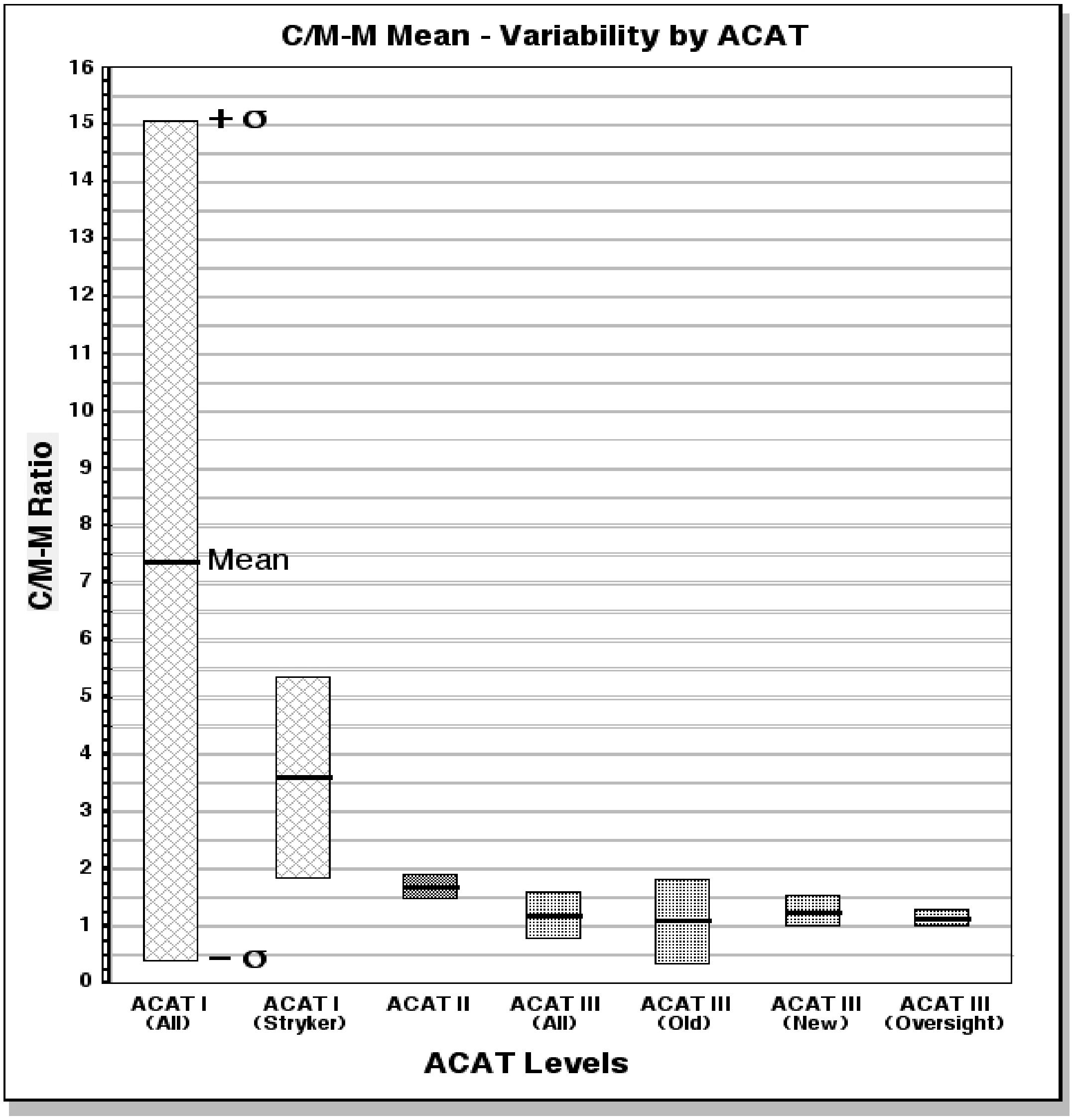

Figure 9. Mean C/M-M Values by ACAT with Standard Deviations

After the requirements-based ratios were calculated at the program level, a summary at the ACAT level was performed. A review of the results for ACAT I, II, and III programs showed a high level of variability, as evidenced by the large standard deviations on the summarized data in Table 14, System Requirements Ratio Summary by ACAT. The standard deviation for all ACAT I programs (All Pgms) was 94.7 percent of the mean value for the C/M-M ratio and the standard deviation for ACAT III (all programs) was 35.9 percent of the mean value for the C/M-M ratio. A second look at the data showed that for ACAT I systems the FCS data was significantly outside of the Stryker vehicles data range, and for ACAT III programs whose TEMPs were dated more than five years ago, appeared to differ significantly from more recent TEMPs. Therefore, additional analysis was performed to look at what effects these data differences may have at the ACAT level. As a result of this finding, Table 14 includes multiple categories within ACAT I and ACAT III summarized data. Additionally, a category for ACAT III oversight programs was added to help answer the research question related to effects of oversight on programs.

The calculations required to generate the data in Table 14 are,

$$\text{Mean C/M-M ratio} = \frac{\sum_{1}^{n} [\text{C/M-M Ratios}]}{n}$$

where,

n=number of ratios in the data set

$$\text{Standard Deviation } (\sigma) = \sqrt{\frac{\sum (x - x)^2}{(n - 1)}}$$

where, x = sample mean average, n = sample size

Mean + σ = Mean C/M-M ratio + σ of C/M-M ratios used to calculate the mean

Mean - σ = Mean C/M-M ratio - σ of C/M-M ratios used to calculate the mean

$$\sigma \text{ as Percent of Mean} = \left(\frac{\sigma}{\text{Mean C/M-M Ratio}}\right) \text{X } 100$$

$$\text{Mean COI/C/M-M ratio} = \frac{\sum_{1}^{n} [\text{COI/C/M-M Ratios}]}{n}$$

where, n = number of ratios in the data set

The C/M-M ratio data was also compared, on a frequency of occurrence basis, to determine if the ratios followed any discernable pattern, either overall or by ACAT level. Table 15, Frequency of C/M-M Value Occurrence by ACAT, lists each C/M-M value obtained versus the total number of occurrences per ACAT. This data is graphed in Figure 8, Frequency Distribution of C/M-M Values by ACAT. The figure shows data that appears to fall into a normal distribution with a bell-shaped curve for ACAT II and ACAT III programs. The broad range and limited data set, three data points, for ACAT I programs showed no discernable pattern in relation to the ACAT II and III programs.

C/M-M Ratio	Frequency of C/M-M Value Occurrence			
	ACAT I	ACAT II	ACAT III (Old)	ACAT III (New)
0.7			1	
0.8			1	
1.0			4	
1.1				3
1.2			1	
1.3				4
1.4			1	
1.6		2		1
1.9		1		
2.3	1			
2.7			1	
4.9	1			
16.2	1			

Table 15. Frequency of C/M-M Value Occurrence by ACAT

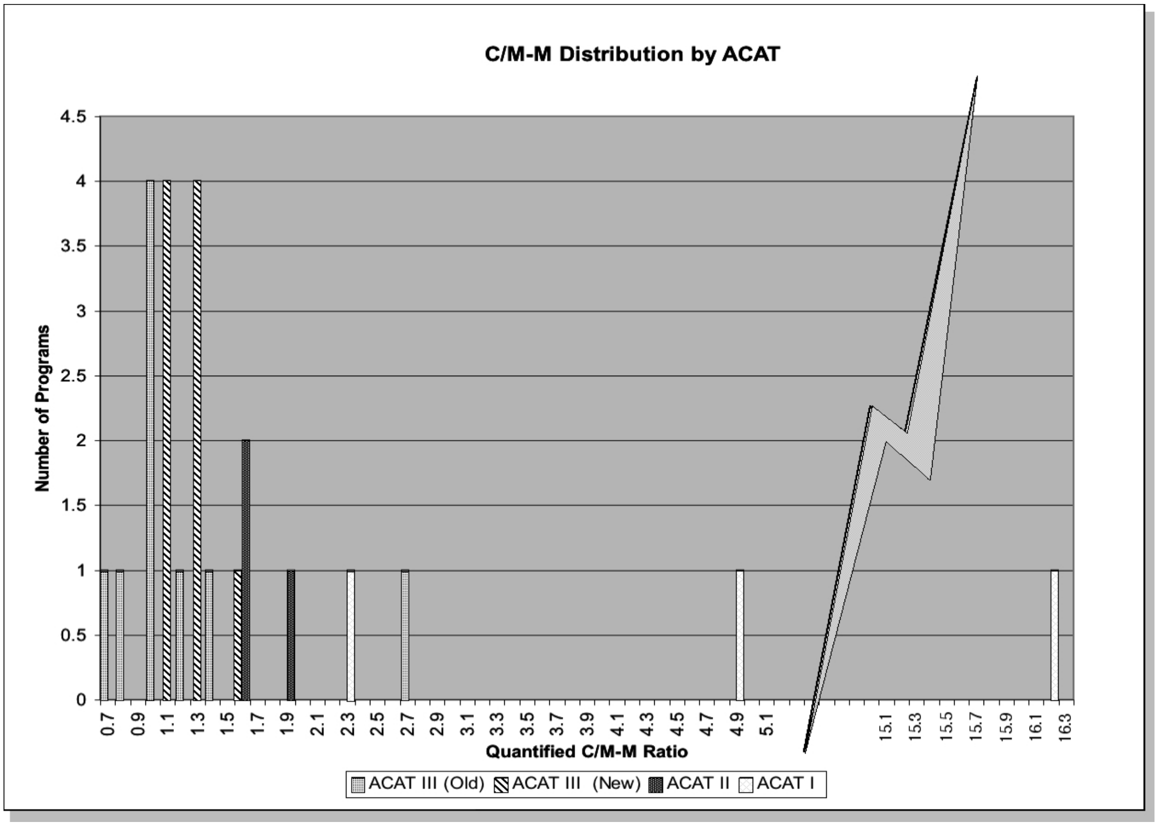

Figure 10. Frequency Distribution of C/M-M Values by ACAT

The requirements analysis results have demonstrated that the C/M-M ratio does differentiate between programs based on ACAT. As a whole, the ACAT III programs have a lower average value for the C/M-M ratio. The ACAT II programs fit into the high end of a normal distribution of frequency of C/M-M ratios when combined with the ACAT III programs. The C/M-M ratios for ACAT I programs are highly variable and are typically much higher than the values found for ACAT II and III programs. A comparison of the quantity of program COIs to the C/M-M ratio does not demonstrate any discernable difference between ACAT levels.

2. Documentation Scope

The second phase of analysis in the investigation of the test-related LoE for programs involves determining the documentation burden posed by the program TEMPs. The overall size of each TEMP and the size of sections I to V was gathered and summarized at the ACAT level and then compared to identify any trends. The page count data from Table 3, COIs and TEMP Page Counts, and the date and oversight status from Table 4, TEMP Data and Oversight Requirements, are summarized in Table 16, TEMP Documentation Size Summary by ACAT. The standard deviation of the TEMP Sections I-V page counts was also calculated and listed in Table 16. The FCS and Stryker ACAT I programs are listed separately in Table 16 due to the extreme differences in documentation scope for these vehicle-based programs. Finally, Table 16 presents the relationship between the mean page counts and the DA Pamphlet 73-1 recommendation of a 30-page maximum for TEMP Sections I-V. The data presented in Table 16 is graphed in Figure 11, TEMP Page Count Comparison by ACAT.

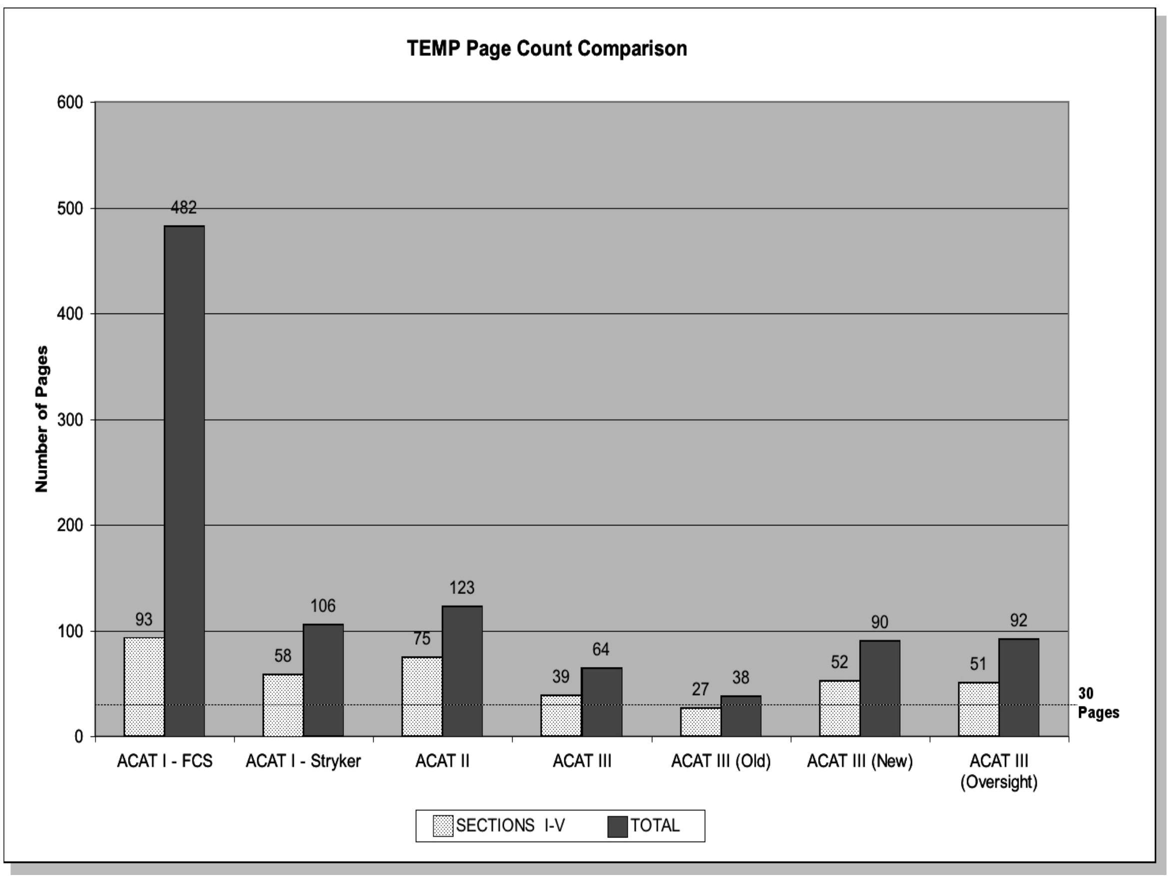

Figure 11. TEMP Page Count Comparison by ACAT

ACAT	TEMP Documentation Size Summary				
	TEMP Section I-V No. Pages	Standard Deviation of Mean TEMP Sec. I-V No. Pages	Standard Deviation, as a Percent of TEMP Sec. I-V Mean No. Pages	TEMP Sec. I-V Pages, as a Percent of 30 page DA PAM Guidance	Mean TEMP Total No. Pages
I (FCS)*	93	N/A	N/A	310%	482
I (Stryker)+	58	0.71	1.2%	192%	106
II	75	17.8	23.8%	249%	123
III (All)	39	17.8	45.8%	129%	64
III (Old)	27	9.7	35.7%	90%	38
III (New)	52	15.6	30.0%	173%	90
III (Over-sight)	51	16.8	33.1%	169%	92

Table 16. TEMP Documentation Size Summary by ACAT

* (FCS data is from a single program TEMP, + Stryker data is from two program TEMPs)

Multiple findings are present in the results of the page count analysis. First, only the older ACAT III program group met the 30-page recommendation for TEMP Sections I-V. Second, the TEMP documentation size for new ACAT III programs does not appear to depend upon program oversight status. Third, the documentation size for ACAT III programs is comparable to that of the ACAT I Stryker programs. Fourth, the ACAT II programs' TEMP documentation size was higher on average than all other programs, with one exception, the ACAT I FCS program.

3. Test Scope

The final phase of analysis in the investigation of the test-related LoE for programs involves reviewing the scope of test related efforts documented in the program TEMPs. The data contained in Tables 5 through 12 was analyzed to determine whether a test-specific relationship exists between a program's ACAT, joint designation, or oversight status. The number of occurrences of each item was summed over the data category (e.g., ACAT II programs; which include the JBPDS, JCAD, and JSLNBCRS) then the mean calculated by dividing the total occurrences by the number of programs in the data set (e.g., three) to determine the value.

Table 17, Test Scope Summary by ACAT, shows the results using the same ACAT-based categories as the requirements and documentation analysis sections. Table 18, Test Scope Summary by Joint and Oversight Status, presents an ACAT neutral view of how a program's jointness or T&E oversight status may impact the LoE. Both tables include columns for the number of programs in each category, the mean number of test evaluation organizations used, the mean number of Army and other test organizations used, and the total of test organizations. Table 17 is organized using the same ACAT-based breakout as in the requirements and documentation analysis to enable one-to-one comparisons of the results. Table 18 is organized to provide insight into joint versus Army-only programs and T&E oversight to see if these attributes drive test efforts.

The test scope evaluation, while limited to a comparison of the numbers of organizations involved in test evaluation and test conduct, provides some insight into the effects of ACAT level, joint designation, and oversight status. A review of the number of test evaluation organizations involved in programs, as graphed in Figure 12 from data in column 3 of Tables 17 and 18, shows several relationships.

ACAT	Test Scope Summary - I				
	Number of Programs	Mean No. of Evaluation Orgs. (	Mean No. of Army Test Orgs.	Mean No. of Other Service + Commercial Test Orgs.	Mean Total of all Test Orgs.
I	3	1.0	9.0	0	9.0
II	3	1.3	5.7	5.7	11.4
III (All)	17	1.9	5.2	1.4	6.6
III (Old)	9	1.1	6.1	0.9	7.0
III (New)	8	2.4	4.1	2.0	6.1
III (Oversight)	3	1.7	3.3	0.7	4.0

Table 17. Test Scope Summary by ACAT

ACAT Independent Program Type	Test Scope Summary - II				
	Number of Programs	Mean No. of Evaluation Orgs.	Mean No. of Army Test Orgs.	Mean No. of Other Service + Commercial Test Orgs.	Mean Total of all Test Orgs.
Joint	10	2.2	4.4	1.9	6.3
Army-Only	13	1.1	6.8	0.6	7.4
Oversight	9	1.3	6.0	2.1	8.1
Non-Oversight	14	1.7	5.6	1.6	7.2

Table 18. Test Scope Summary by Joint and Oversight Designation

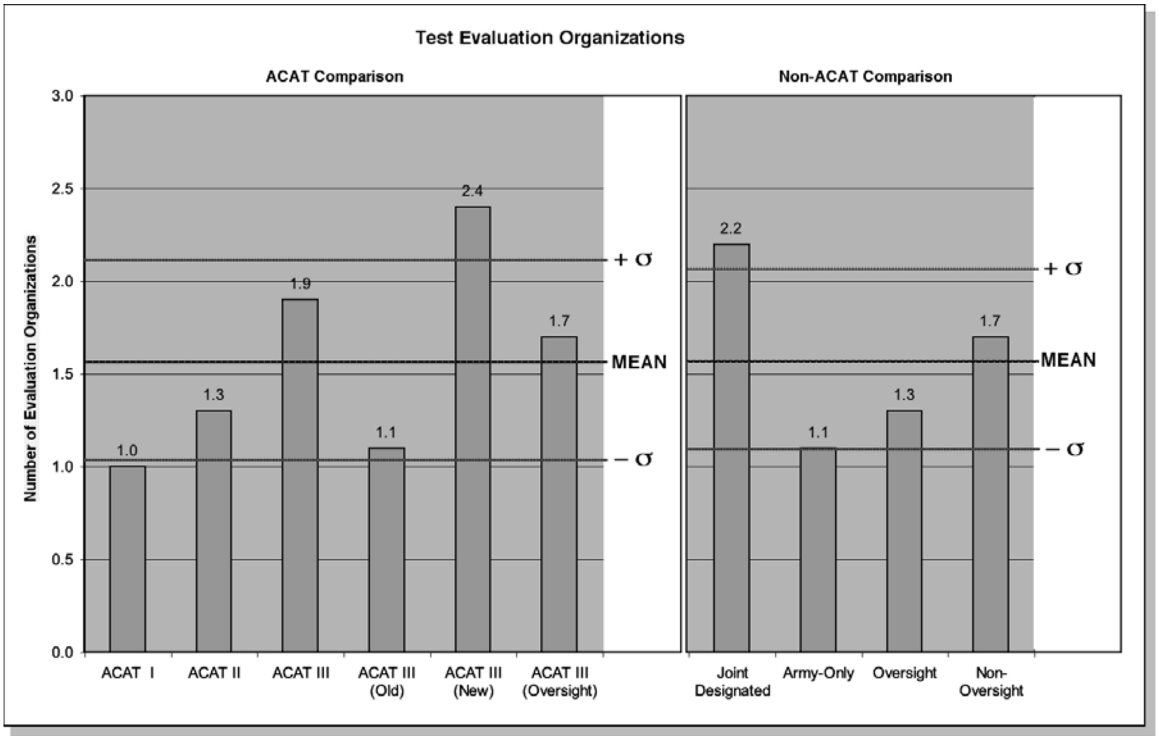

Figure 12. Test Evaluation Organization Involvement

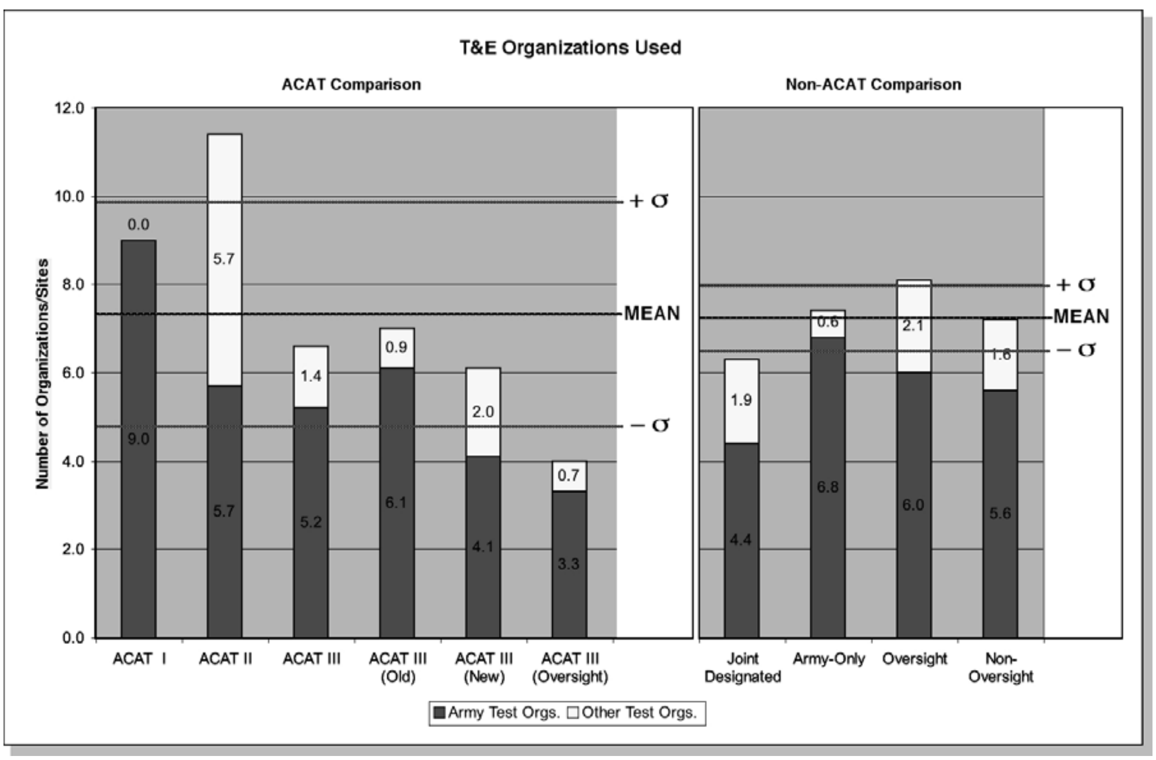

Figure 13. Number of Test Organizations/Sites Used

ACAT I, ACAT III (Old), and Army-Only programs utilized, on average, only one evaluation organization. This result makes intuitive sense, as all three of these program types are Army-only or non-joint designated programs. For these programs AEC filled the test evaluation role.

ACAT III (New) and Joint Designated programs have the highest average number of involved evaluation organizations. It also was expected that these two categories of programs would have similar values, since seven of the eight ACAT III (New) programs evaluated were joint programs. The other joint programs analyzed were the three ACAT II programs, which had a lower value than the ACAT III's, which pulled the joint designated average down slightly. This category had more than twice the average number of evaluators as the Army-only and ACAT I programs.

ACAT III (Oversight) and all non-oversight programs had the same value of 1.7 organizations, and ACAT II and all oversight programs had a lesser, but identical value of 1.3 organizations. These results demonstrate that program oversight generally reduces the number of test evaluators involved in a program, and that ACAT III oversight programs have a similar evaluator involvement as most programs without oversight.

Figure 12 is split, with the left side showing an ACAT-based comparison, and the right side showing the non-ACAT factors that may contribute to differences between programs. The analysis of test evaluation organizations depicted in Figure 12 shows nearly identical means and standard deviations, regardless of the basis of comparison. The means and standard deviations are 1.57 and 0.54 for ACAT-based, and 1.58 and 0.49 for non-ACAT-based views. Therefore, the ACAT and the other factors evaluated are equivalent in their influence on the results.

The scope of T&E efforts related to numbers of test organizations, and test sites, used is depicted in Figure 13, which is also split to allow ACAT and non-ACAT comparisons. Most programs fall within a one standard deviation band of total test organization and site usage. As would be expected, Army-only programs tended to primarily use Army test sites. Only ACAT II and ACAT III (Oversight) programs fell outside of the one standard deviation band. ACAT II programs used as many non-Army test organizations and sites as Army ones, while ACAT III (Oversight) programs are significantly below this band. Interestingly, the category that used the fewest organizations and sites was ACAT III (Oversight).

The non-ACAT comparison of test sites in Figure 13 shows a much lower standard deviation than the ACAT-based results. The means and standard deviations are 7.35 and 2.55 for ACAT-based, and 7.25 and 0.74 for non-ACAT-based views. This demonstrates that the ACAT is the primary factor for differences in the number of test organizations and sites used.

E. CHAPTER SUMMARY

The analysis of the data shown in Chapter III was performed in three parts, system requirements, documentation scope, and test scope. The analysis was performed on twenty-three programs, primarily using data extracted from TEMPs, to answer the primary and secondary research questions.

The requirements analysis has shown that ACAT III CB programs have the most technically-oriented, quantifiable, MOE and MOS. ACAT II CB program MOE and MOS are only slightly less quantifiable than those of ACAT III CB programs. The ACAT I programs evaluated had the least technically focused MOE and MOS requirements.

The documentation scope analysis determined that none of the current CB and Army programs met the DA Pamphlet 73-1 guidance for Sections I-V TEMP pages. Also, TEMPs for an average ACAT III CB program are equivalent in volume to the ACAT I Stryker programs. The impact of oversight could only be evaluated for ACAT III programs, where no noticeable differences in TEMP scope could be discerned.

The test-related analysis determined that the average number of test evaluation organizations used was not directly related to the ACAT level. There were two outliers in the analysis, one was ACAT I programs and the other was joint-designated programs. ACAT I programs used only one evaluation organization, while joint-designated programs averaged more than twice that number.

The test related analysis also did not find any noticeable trends between for the joint designated, Army-only, oversight, or non-oversight categories. However, ACAT III (Oversight) programs and ACAT II programs were statistically outside of the norm for average number of test organizations and sites used. The extensive use of non-Army test facilities drove the ACAT II programs significantly higher than other program categories, while the reason that ACAT III (Oversight) programs were significantly lower than other programs was not directly evident.

In summary, the analysis has determined that,

- ACAT II programs are the most burdened CB programs; combining highly-technical MOEs and MOSs, joint-designation, the highest TEMP documentation burden, and the broadest test scope.
- ACAT I programs are the least burdened by technical MOE and MOS requirements, while ACAT III programs are the most burdened.
- Oversight appears to have a neutral to positive impact on ACAT III programs.
- The TEMP documentation burden for CB programs is not related to ACAT.
- Joint-designation noticeably increases the test and documentation burden.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

This chapter presents the conclusions reached regarding the primary and secondary research questions of this study. The conclusions are derived from the analysis conducted in Chapter IV, using the background information presented in Chapter II, the data presented in Chapter III, and the overall scope of the study. Recommendations for further research are presented in order to focus potential follow-on investigations toward areas that will help complete the overall picture of ACAT-related program test burden. A recommendation related to TEMP implementation is also presented to foster discussions of T&E management processes.

B. CONCLUSIONS

Level of Effort is a key phrase in all three study research questions. This research study evaluated the LoE for T&E within a program using three factors,

- How technically focused the operationally evaluation parameters, MOE and MOS, were in relation to the technical evaluation parameters, CTPs.
- The T&E documentation burden to a program, based on the TEMP size.
- The number of T&E organizations involved in the conduct and evaluation of program tests.

1. Primary Research Question – T&E LoE and ACAT

The primary research question is, "Is the Test and Evaluation (T&E) Level of Effort (LoE) proportional to the ACAT level?"

<u>The T&E LoE is not proportional to the ACAT level.</u>

Each ACAT level scored best in one or more, and worst in one or more, of the categories evaluated. The T&E LoE was analyzed using the three factors listed above. The ACAT I programs evaluated had the best differentiated technical and operational requirements and used the least number of evaluation organizations. ACAT II programs had technically-based operational requirements, a high LoE for TEMP documentation, and used the most test sites. ACAT III programs had the most technically-based operational requirements, similar TEMP documentation to the other ACATs, with the most evaluator involvement, but used less test sites overall. These conflicting results cemented the conclusion that ACAT level and T&E LoE do not correlate directly.

2. Secondary Research Question – Oversight

The first secondary research question is "How does program oversight by the Director Operational Test and Evaluation or the Army drive the T&E LoE?"

<u>T&E oversight had a neutral to positive effect on ACAT III CB programs.</u>

Oversight comparisons could only be performed for ACAT III programs, as there were no non-oversight ACAT I and II programs in this study. ACAT III oversight programs showed improvements over non-oversight programs by using fewer test sites and through less variability in the C/M-M ratio within the TEMP. The overall C/M-M ratio, the TEMP LoE, and the number of test evaluators were all comparable to non-oversight ACAT III programs.

3. Secondary Research Question – CB Programs

The second secondary research question is "Are Chemical/Biological (C/B) programs a special case for T&E LoE?

<u>An answer to this question could not directly be determined.</u>

Since only three of the programs studied were not part of the CBDP, and they were all ACAT I programs, there was insufficient data to determine whether CB programs are unique within DoD for their T&E LoE. Data related to the joint nature of most CB programs was gathered and analyzed, but this data was not broad enough to answer this overarching question.

C. RECOMMENDATIONS

1. Areas of Further Study

Although this research study was able to find useful relationships between programs of different ACATs, including the development of a new requirements quantification ratio, it was constrained by the limitations of the available data. Specific additional study areas that have the potential to significantly increase the overall understanding of how T&E is performed on different ACAT-level programs are,

- An analysis of acquisition programs in other commodity areas within DoD, using this study's methodology. This research will help determine whether CB programs are typical or unique within DoD.
- An analysis of program T&E funding to overall program funding on an ACAT and non-ACAT basis, for both Research, Development, Test & Evaluation (RDT&E) and Procurement funds for CB programs. This research will enable a requirements versus cost analysis, which was not able to be completed with existing TEMP cost data.
- An analysis of the number and types of tests conducted, based upon ACAT and non-ACAT factors. This information will provide the final details necessary to determine what, if any, factors drive detailed program tests.

2. T&E Program Implementation

One area that should be reevaluated is the Army's recommendation for no more than 30 pages for Sections I-V of a TEMP. Only the older ACAT III programs studied met this goal, and current Army/CBDP TEMPs appear to have normalized on a 50-60 page average. Since none of the current acquisition programs studied met this requirement, regardless of ACAT, the time may be right to rethink this guidance.

D. SUMMARY

This research study was undertaken to investigate the validity of the common belief that smaller programs endure a disproportionately heavy T&E burden relative to larger programs. In general, this notion was proven true. ACAT III programs have the most technically detailed operational requirements, but do gain some benefit from focused oversight. However, ACAT II programs endure the 'worst of all worlds' when it comes to T&E burden. It appears that ACAT II CB programs are managed as if they were ACAT I-D OSD/DOT&E oversight programs, while also having an ACAT III-like burden of highly technically-biased operational requirements. Further study is needed to determine whether this T&E bias applies to non-CB programs, or is unique to the CBDP.

APPENDIX. PROGRAM FACT SHEETS

Future Combat Systems (FCS)

The Army's Future Combat Systems (FCS) network allows the FCS Family-of-Systems (FoS) to operate as a cohesive system-of-systems where the whole of its capabilities is greater than the sum of its parts. As the key to the Army's transformation, the network, and its logistics and Embedded Training (ET) systems, enable the Future Force to employ revolutionary operational and organizational concepts. The network enables Soldiers to perceive, comprehend, shape, and dominate the future battlefield at unprecedented levels as defined by the FCS Operational Requirements Document (ORD).

The FCS network consists of four overarching building blocks, System-of-Systems Common Operating Environment (SOSCOE); Battle Command (BC) software; communications and computers (CC); and intelligence, reconnaissance and surveillance (ISR) systems. The four building blocks synergistically interact enabling the Future Force to see first, understand first, act first and finish decisively.

http, //www.army.mil/fcs/overview.html (Nov 2007)

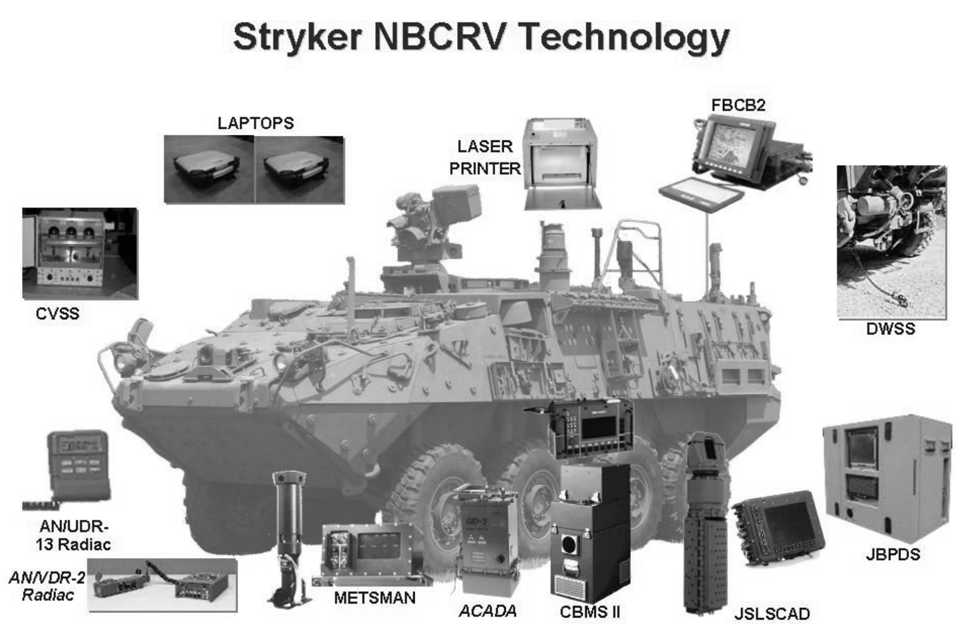
http, //www4.army.mil/OCPA/uploads/large/FCSnetwork2004-07-23.jpg (Nov 2007)
http, //www4.army.mil/OCPA/uploads/large/Mortar2004-10-19.jpg (Nov 2007)

NBC Reconnaissance Vehicle (NBCRV) – Stryker Variant

The Nuclear, Biological, Chemical Reconnaissance Vehicle (NBCRV) provides on the move and remote near-real-time nuclear, biological and chemical detection and surveillance to supply battlefield visualization of NBC hazards.
General,
The NBC RV provides NBC situational awareness to increase the combat power of the SBCT. The core of the NBC RV is its on-board integrated NBC sensor suite and integrated meteorological system. An NBC positive overpressure system that minimizes cross-contamination of samples and detection instruments, provides crew protection, and allows extended operations at MOPP 0.
Operational Capability,
The NBCRV will have the capability to detect and collect chemical and biological contamination in its immediate environment on the move through point detection (CBMS and JBPDS), and at a distance through the use of a stand off detector (JSLSCAD). It automatically integrates contamination information from detectors with input from on-board navigation and meteorological systems and automatically transmits digital NBC warning messages through the Maneuver Control System to warn follow-on forces. Mission, NBC Reconnaissance. Find, identify, map, and mark NBC contamination on the non-linear battlefield.

- 32-57% reduced route reconnaissance mission time via on-the-move standoff chemical agent detection
- Common NBC technical architecture
- Biological Detection Capability (CBMS and JBPDS)

Digitized division/corps-fused NBCRS architecture



http, //www.sbct.army.mil/ (Nov 2007), http, //www.jpeocbd.osd.mil/Recon/Products-CA-NBCStryker.html (Nov 2007)

Stryker Family of Vehicles

Stryker™ is a family of eight-wheel drive combat vehicles, transportable in a C-130 aircraft, being built for the US Army by GM GDLS, a joint venture set up by General Motors Defense of Canada and General Dynamics Land Systems Division of USA. Stryker is based on the GM LAV III 8 x 8 light-armored vehicle, in service since early 2001. The LAV III is itself a version of the Piranha III built by Mowag of Switzerland, now owned by General Motors Defense. GM Defense and GDLS are sharing the fabrication and final assembly of the vehicles among plants at Anniston, Alabama; Lima, Ohio; and London, Ontario.

The Stryker Brigade Combat Team (SBCT) combines the capacity for rapid deployment with survivability and tactical mobility. The Stryker vehicle enables the team to maneuver in close and urban terrain, provide protection in open terrain and transport infantry quickly to critical battlefield positions.

GM Defense and GDLS were awarded the contract for the US Army's Interim Armored Vehicle (IAV) in November 2000.

The eight-wheeled Stryker is the first new military vehicle to enter service into the United States Army since the Abrams tank in the 1980s.

The United States Army first deployed 14 Stryker vehicles as part of its forced entry package for Millennium Challenge 2002, the Joint Forces Command field experiment and demonstration in July and August 2002. The Strykers were deployed from C-130 and C-17 aircraft during the exercise. Formal brigade certification is planned for May 2003.

Variants,
Stryker variants include the Infantry Carrier Vehicle (ICV) and the Mobile Gun System (MGS). There are eight configurations of the ICV including Nuclear, Biological, Chemical Reconnaissance Vehicle (NBC RV); Anti-Tank Guided Missile (ATGM); Medical Evacuation Vehicle (MEV); Mortar Carrier (MC); Engineer Squad Vehicle (ESV); Commander's Vehicle (CV); Fire Support Vehicle (FSV); and the Reconnaissance Vehicle (RV). They have parts commonality and self-recovery abilities and are equipped with a central tire inflation system.

http, //www.sbct.army.mil/ (Nov 2007)

Joint Biological Point Detection System (JBPDS)

Description,
The Joint Biological Point Detection System (JBPDS) Acquisition Category II (ACAT II) Sentinel program is the successor to the Army BIDS, Navy IBAD, and the Air Force service specific development programs. The JBPDS will meet Quad-service requirements as outlined in the Joint Operational Requirements Document (JORD) and consist of complementary trigger, sampler, detector and identification technologies to rapidly and automatically detect and identify biological threat agents. The suite will be capable of identifying BW agents in less than 15 minutes. The suite will be capable of identifying, as a minimum, BW agents listed in Category A of the International Task Force (ITF) 6 Report, dated Feb 90. The detection suite will be integrated into each Service's platform (e.g. BIDS, surface ships, LNBCRS) or air base and port to provide a common detection capability for joint interoperability and supportability. The JBPDS will increase the number of agents that can be identified by the BIDS and the IBADS; decrease detection and identification time; increase detection sensitivity; provide automated knowledge-based detection and identification; and provide a first time point detection capability to the Air Force and Marine Corps.

Mission,
To detect, identify, sample, collect and communicate the presence of biological warfare agents to enhance the survivability of U.S. Forces.

Capabilities,
- Point detection capability for all Services
- Increased reliability and maintainability
- Identify 10 biological warfare agents simultaneously

Improvements over the BIDS and IBAD,
- Lower probability of false positive identification
- Interface with JWARN System and FBCB2
- Fully automated detection and identification capability

User,
U.S. Army, U.S. Navy, U.S. Air Force, and U.S. Marine Corps

http, //www.jpeocbd.osd.mil/page_manager.asp?pg=7&sub=18 (Nov 2007)

Joint Chemical Agent Detector (JCAD)

Description,
The JCAD will be a combined portable monitoring and small point chemical agent detector for aircraft, shipboard, and individual soldier applications. This hand-held, pocket-sized detector is required to automatically detect, identify, and quantify chemical agents inside the aircraft or ship, providing protection for the individual Soldier, Sailor, Airman, or Marine. For the duration of the mission, the device must be sufficiently sensitive to warn aircrews before accumulation of a dose that will cause miosis or more severe effects. It must be resistant to the severe interferent environment on a naval vessel and be small and rugged for individual use.

Mission,
Advanced detection and warning, identification of contamination on personnel and equipment, and monitoring for the presence of chemical warfare agent contamination

Capabilities,
- Instant feedback of hazard (mask only or full MOPP)
- Real-time detection of nerve, blister, and blood agents
- Miosis-level detection capability (with pre-concentrator)
- Calculates accumulated dosage
- Stores up to 72 hours of detection data
- Fully compatible with Joint Warning and Reporting System (JWARN)

Users,
U.S. Air Force (Program Lead), U.S. Army, U.S. Navy, and U.S. Marine Corps Replaces the

http, //www.jpeocbd.osd.mil/Point/Products-CA-JCAD.html (Nov 2007)

Joint Services Lightweight NBC Reconnaissance System (JSLNBCRS)

Description,
The JSLNBCRS will provide point and standoff intelligence for real-time field assessment of NBC hazards. The system is a vehicle-mounted suite of equipment and software designed to detect, collect, analyze, mark, and disseminate NBC data. Two variants, the High Mobility Multipurpose Wheeled Vehicle and the Light Armored Vehicle, will house the same equipment and offer on-the-move, standoff capability, while providing an air-transportable system. Timely provision of automated, digital information meshed with meteorological and positioning information will provide commanders more options in merging NBC information with tactical, operational, and strategic plans.

Mission,
Perform NBC Reconnaissance. The JSLNBCRS will detect, identify, mark, collect, correlate, and disseminate NBC hazard and toxic industrial chemical information over an automated warning and reporting information network.

Capabilities,
- JSLSCAD - On-the-Move near real-time chemical vapor detection
- CBMS II- Chemical Detection
- JBPDS- Biological Detection
- ACADA - Chemical warfare agent detection (nerve and blister agents)
- ADM 300A - AN/VDR-2 - Measures radioactivity for either vehicle-mounted or hand-held operations
- ICAM/CAM II - Hand-held monitoring of chemical agents
- JWARN to analyze and report NBC hazards

Improvements,
- On-the-move standoff chemical detection
- Biological detection and sampling
- On-the-move meteorological system
- Significantly less impact on strategic and intra-theater lift resources
- Collective protection for crew against known CBW agents.
- Generation of automated NBC warning messages.

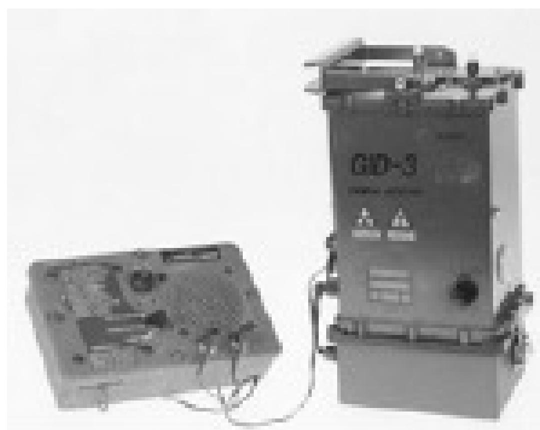
Users,
U.S. Marine Corps and U.S. Air Force

http, //www.jpeocbd.osd.mil/Recon/Products-CA-JSLNBCRS.html (Nov 2007)

M22/M88 Automatic Chemical Agent Detection Alarm (ACADA)

Description,
The M22 Automatic Chemical Agent Alarm (ACADA) is an automatic chemical agent alarm system capable of detecting, warning and identifying standard blister and nerve agents simultaneously. The M22 is man-portable, operates independently after system start-up, provides an audible and visual alarm and provides communication interface to support battlefield automation systems.
Mission,
Provide detection and warning for nerve and blister agents.
Capabilities,
- Area warning
- Collective Protection Equipment (CPE) monitoring
- Operation on and in vehicles
- Compatible with MICAD
- Provides simultaneous detection and warning of nerve and blister agents
- Significantly more sensitive than M8A1
- Operates in a collective protection environment
- Much less responsive to interferences
- Able to operate in and on vehicles

Users,
U.S. Army, U.S. Navy, U.S. Air Force and U.S. Marine Corps



http, //www.jpeocbd.osd.mil/Point/Products-CA-ACADA.html (Nov 2007)

Analytical Laboratory System (ALS)

Description, The Analytical Laboratory System (ALS) is a C-130 air transportable system thatuses commercial-off-the-shelf (COTS) equipment that can analyze ChemicalWarfare (CW) agents, Toxic Industrial Materials (TIM), Toxic Industrial Chemicals (TIC) and Biological Warfare (BW) agents. The ALS has the capability of establishing communications through the Unified Command Suite (UCS) to local, state, federal laboratories and other Agencies for confirmatory analysis of supect agent.

Mission, The ALS provides the capability to the Civil Support Teams to conduct presumptive analysis of unknown or potential agents at an incident site and transmit that information electronically via the UCS in support of the First Responder Incident Commander.

Capabilities,
Detects and identifies GB, GD and HD
Self - contained and fully functional and reliable in the range of extreme climates encountered in the United States and its territories
Provides results from screening of TIC/TIM/CW samples within 30 minutes
Provides results from screening of BW samples within 45 minutes

User, National Guard Bureau, Weapons of Mass Destruction - Civil Support Teams.

http, //www.jpeocbd.osd.mil/page_manager.asp?pg=2&sub=19 (Nov 2007)

Biological Integrated Detection System (BIDS)

Description,

The Biological Integrated Detection System (BIDS) is an early warning and identification capability in response to a large area (theater) Biological Warfare (BW) attack. The system is a detection suite installed in a shelter that is mounted on a dedicated vehicle with trailer mounted generator power supply. Other BIDS elements include collective protection, environmental control, sample storage, GPS, MET, and radios. The BIDS pre-planned product improvement BIDS (P3I) system is equipped with a detection suite to include high volume samplers, a fluorescent particle counter/sizer, a flow cytometer, a chemical/biological mass spectrometer and an antibody-based biological detector. The shelter may be removed from the vehicle for fixed site application. The BIDS program was conducted in three phases. Phase I was the non-developmental item (NDI) BIDS. Phase II was the P3I, which provided technology insertion to upgrade the NDI core configuration from a four-agent to an eight-agent identification capability with improved generic detection. The objective system (Phase II) transitioned to JBPDS.

Mission,

Detect and identify large-area Biological Warfare (BW) agent attacks, provide a basis for large-area protection and warning.

Capabilities,

- BIDS NDI
  - Detect/Identify 25 ACPLA/30Min
  - Manual operation
- BIDS P3I
  - Detect/Identify 15 ACPLA/20Min
  - Semi-automatic operation
- BIDS Obj System
  - JBPDS Bio Suite

Improvements over prior systems,

- First Army biological detection capability
- Basis for rapid detect-to-treat decisions
- Provide improved situational awareness

User,

U.S. Army

http, //www.jpeocbd.osd.mil/page_manager.asp?pg=7&sub=17 (Nov 2007)

Chemical and Biological Protective Shelter (CBPS)

Description,
The Chemical and Biological Protective Shelter (CBPS) provides a highly mobile, contamination free, environmentally controlled work area for forward deployed medical treatment units. The CBPS consists of a dedicated M1113 HMMWV vehicle, a Lightweight Multipurpose Shelter (LMS) mounted on the back of the HMMWV, a 300 ft^2 semi-cylindrical airbeam-supported soft shelter, and a towed High Mobility Trailer with 10kW Tactical Quiet Generator (TQG) for auxiliary power. Four soldiers operate the CBPS; during transport, two ride in the HMMWV and two in the LMS. Soldier's gear and required medical equipment will be stored in the LMS or on the trailer. The inflatable shelter is rolled and carried on the rear of the LMS during transport. All power required to support operations of the sys-tem is provided by the HMMWV engine via an underhood hydraulic pump, or from the auxiliary 10kW TQG. A hydraulically-powered Environmental Support System mounted on the front of the LMS provides heating, cooling, airbeam inflation, CB filtration, and ventilation air.
Mission,
CBPS will be fielded to Treatment Squads, Forward Surgical Teams, and Medical Companies and will allow medical personnel to work without encumbrances of protective clothing in a CB contaminated environment.
User, Full Materiel Release achieved and fielded to U.S. Army and U.S. Marine Corps during Operation Iraqi Freedom
Capabilities,

- Highly Mobile self-contained system
- CBPS can be fully operational in less than 20 minutes
- Personnel work inside without encumbrances of protective gear
- Provides a clean environment for medical care, to include a desert environment
- Environmentally controlled sustained operations -25^{o} F to 120^{o} F


http, //www.jpeocbd.osd.mil/documents/CBPS_Handout2.pdf (Nov 2007)

M93A1 Fox Nuclear, Biological, Chemical Reconnaissance System (NBCRS)

Description,
The M93A1 FOX NBCRS is a dedicated system of nuclear and chemical sampling, detection, and warning equipment, and biological sampling equipment integrated into a high speed, high mobility, six wheel armored vehicle. It is capable of performing nuclear, biological, and chemical (NBC) reconnaissance on primary, secondary, or cross-country routes throughout the battlefield. The M93A1 is the Block 1 improvement of the M93 FOX NBCRS Interim System to meet all of the requirements of the approved required operational characteristics (ROC), and reduce the crew size to three. It is capable of detecting chemical contamination in its immediate environment through point detection, and at a distance through the use of a standoff detector (M21 Chemical Agent Detector Alarm). It automatically integrates contamination information from detectors with input from on-board navigation and meteorological systems and automatically transmits digital NBC warning messages through the Maneuver Control System to warn follow-on forces.

Mission,
NBC Reconnaissance. Find, identify, map, and mark NBC contamination on the battlefield.

Capabilities,
- Standoff vapor detection
- Reduced crew size
- Digitized communications
- On-board MICRO-MET, GPS, SINCGARS
- Automatic Alarm Reporting (MICAD)

Future Improvements,
- FOX Recapitalization - Zero hours/Zero Miles, Enhanced Sensor Suite, Improved Survivability and Lethality
- Significantly reduced operational, sustainment and life cycle costs

Users,
U.S. Army, U.S. Marine Corps

http, //www.jpeocbd.osd.mil/Recon/Products-CA-FOXBlockI.html (Nov 2007)

Joint Biological Agent Identification and Diagnostic System (JBAIDS)

Description, The Joint Biological Agent Identification and Diagnostic System (JBAIDS) is an integrated system for rapid identification and diagnostic confirmation of biological agent exposure or infection. Based on commercial technology, JBAIDS is man-portable, reusable, and will be capable of the simultaneous identification of multiple Biological Warfare agents (BWA) and other pathogens of operational concern. The system consists of the hardware platform to perform sample analysis, a laptop computer for readout display, and assay reagent test kits.

Mission,

Provide rapid positive identification and diagnostic confirmation of BWA and other pathogens of operational concern.

Capabilities,

- Single DoD accepted platform for both identification and diagnostic confirmation of biological agents
- Operation in fixed medical laboratories and deployed medical units
- Operates as a stand-alone system; future development Blocks II and III to be interoperable with Theatre Medical Information Program (TMIP)

Improvements over existing technology,

- Provides simultaneous identification of multiple biological agents
- Rapid identification

User,
U.S. Army, U.S. Navy, U.S. Air Force, and U.S. Marine Corps.

http, //www.jpeocbd.osd.mil/page_manager.asp?pg=2&sub=54 (Nov 2007)

Joint Biological Standoff Detection System (JBSDS)

Description,
The JBSDS is in development and is the first joint biological standoff detection program. The JBSDS will be a standoff early warning biological detection (BD) system. The system will be capable of providing near real time, detection of biological attacks/incidents and standoff early warning detection/warning of biological warfare (BW) agents at fixed sites or when mounted on multiple platforms, including NBC reconnaissance platforms. It will be capable of providing standoff detection, ranging, tracking, discrimination (manmade vs natural occurring aerosol) and generic detection (bio vs non-bio) of large area BW aerosol clouds for advanced warning, reporting, and protection.

Mission,
To provide a biological detection network capable of near real time detection and warning, theater wide, to limit the effects of biological agent hazards at the tactical and operational levels of war.

Capabilities,
- Provides integrated, stand-off detection near real time for Bio- Detect and track aerosol clouds out to 15km
- Operate at fixed site or stationary mode from mobile platforms
- Discriminate Bio particles from non Bio particles in aerosol clouds out to 3km
- Operationally skin and eye safe

Improvements over previous systems,
- JBSDS will provide early warning BWA standoff for all Services. Currently fielded biological detection systems do not.
- JBSDS will discriminate between natural and man-made aerosols.
- JBSDS will not require aviation assets for employment. Existing LRBDS does.

User,
U.S. Army, U.S. Navy, U.S. Air Force, and U.S. Marine Corps

http, //www.jpeocbd.osd.mil/page_manager.asp?pg=7&sub=19 (Nov 2007)

Joint Protective Aircrew Ensemble (JPACE)

Description,
The Joint Protective Aircrew Ensemble (JPACE) is a Chemical Biological Protective garment that is fire resistant and provides protection from Chemical/Biological (CB) warfare agents and radiological particles. JPACE is intended for use by all aviators and aircrew for fixed wing ejection, fixed wing non-ejection, and rotary wing personnel.

Mission,
Provide below-the-neck chemical/biological protection for aviators and aircrew personnel.

Capabilities,
♦ Chemical protection from all liquid, particle, vapor and aerosol CB agents
♦ Provides protection to enhance combat capabilities in a CB environment
♦ Compatible with all services aviation ALSS/ALSE, legacy Chem/Bio Aviation mask systems, all developmental masks, JSLIST Glove Block Upgrades, foot wear solutions, and the Army's Air Warrior system.

Improvements over the current garments, Replaces, Navy Mk1, CPU-CWU-27P; Army ABDU-BDO, CPU-ABDU; Air Force CWU-66/PIncreased CWBW agent protection
♦ Increased flame protection
♦ Longer post exposure protection
♦ Decreased heat stress

Repair kits for both the outer shell and the line for field expedient and repair for reuse.

Laundering cycles, shelf/service life is increased.

User,
U.S. Army, U.S. Navy, U.S. Air Force, U.S. Marine Corps, U.S. Coast Guard and U.S. Special Operations Command.

http, //www.jpeocbd.osd.mil/documents/IP-JPACE_(L).pdf (Nov 2007)

XM50/51 Joint Service General Purpose Mask (JSGPM)

The JSGPM will be a lightweight, protective mask system (consisting of mask, carrier and accessories) incorporating state of the art technology to protect U.S. forces from anticipated threats. The mask components will be optimized to minimize impact on the wearer's performance and to maximize its ability to interface with future Service equipment and protective clothing.

Mission,

Provide face, eye, and respiratory protection from battlefield concentrations of Chemical and Biological (CB) agents, toxins, toxic industrial materials, and radioactive particulate matter.

User,

All Services - Replaces the M40/42 and MCU-2/P Series Masks, and the M45 in the Land Warrior Program.
Target Capabilities, - Provide 24 hours of above the neck protection from CB agents, radioactive particles, and toxic industrial materials- Overall field of view 80%
- Inhalation resistance 30 mm water
- Compatible with current and co-developmental CB garments

Target Improvements over the M40/42, MCU-2/P, and M45,
- Reduced weight and bulk
- Lower breathing resistance
- Improved equipment compatibility
- Improved and increased periods of protection

http, //www.jpeocbd.osd.mil/page_manager.asp?pg=2&sub=40 (Nov 2007)

Joint Block 1 Glove Upgrade Program (JB2GU)

Description,
The JB2GU is a system that will provide protection against chemical/biological (CB) warfare agents. It is a component of the JSLIST ensemble and will improve upon the JB1GU effort by offering greater durability that will satisfy a broader set of known requirements, specifically, JSLIST ground and shipboard use and aviation. JB2GU will be used with the JSLIST and JPACE ensemble and chemical protective mask.

Target Capabilities,
The JB2GU will provide hand protection from liquid, vapor, and aerosol Chemical/Biological (CB) hazards. It will provide enhanced tactility, dexterity, and comfort over existing systems and can be worn in all climates. The glove will offer 24 hours of protection in a contaminated environment and is durable up to 30 days.

How JB2GU is Used,
The warfighter will use the JB2GU glove along with the JSLIST and JPACE ensembles, footwear and masks to create a state-of-the-art chemical/biological protective ensemble that provides complete percutaneous and respiratory protection against chemical and biological warfare (CBW) agents.

User,
U.S. Navy, U.S. Air Force, U.S. Army, and U.S. Marine Corps.

http, //www.jpeocbd.osd.mil/page_manager.asp?pg=2&sub=36 (Nov 2007)

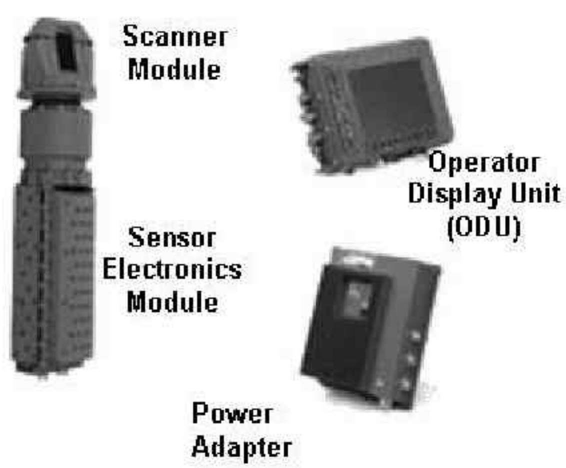
Joint Services Lightweight Standoff Chemical Agent Detector (JSLSCAD)

Description,
The Joint Services Lightweight Standoff Chemical Agent Detector (JSLSCAD) is a state-of-the-art detection system designed to provide U.S. Forces with enhanced capability in detecting chemical warfare agents. It is a lightweight, passive, and fully automatic detection system that scans the surrounding atmosphere for chemical warfare agent vapors. It furnishes on-the-move, 360° coverage from a variety of tactical and reconnaissance platforms at distances up to 5 kilometers. It is a second-generation system that significantly improves on the capabilities of the currently fielded M21 Remote Sensing Chemical Agent Alarm (RSCAAL). The JSLSCAD will provide war fighters with enhanced early warning to avoid chemically contaminated battlespace. When avoidance is not possible, The JSLSCAD will give personnel extra time to don MOPP gear.

Mission,
Provide standoff detection and warning for nerve, blister, and blood agent vapor clouds.

Capabilities,
- Detects, identifies and reports nerve, blister, and blood agent vapor clouds
- Mounts on ground, air and sea platforms
- Provides 360° by 60° on-the-move coverage
- Provides up to 5 km detection range
- No operator required
- Automatic warning and reporting through JWARN

Users,
U.S. Army, U.S. Marine Corps, Future, U.S. Air Force, U.S. Navy



http, //www.jpeocbd.osd.mil/Standoff/Products-CA-JSLSCAD.html (Nov 2007)

JSFDS Joint Services Family of Decontamination Systems [Includes JSTDS-SS]

Description, Joint Service Family of Decontamination Systems (JSFDS) is designated to incorporate across the DoD a family of decontamination systems that will provide personnel, equipment and area decontamination of all chemical and biological warfare agents to a level safe for return to unrestricted operational use.
Mission, To develop chemical and biological decontamination/application systems for equipment, wounded and non-wounded personnel.

User, U.S. Army, U.S. Navy, U.S. Air Force, and U.S. Marine Corps

M100 NSN, 4230-01-466-9095 Bracket NSN, 5340-01-466-5928

Capabilities,

- Decon of fixed facilities, ports of entry, airfields
- Dispensing of the entire family of decontaminants regardless of form
- Personnel skin decontamination capability for use on casualties - with and without open wound.
- Improvements over current capabilities
- Provides a common capability to decontaminate facilities, structures, etc.
- Introduction of skin decontamination treatment

Unification of dispensing methods

NOTE, Requirements for the JSTDS-SS are found in the Joint Service Family of Decontamination Systems (JSFDS) Joint Service Transportable Decontamination System (JSTDS) Milestone (MS) B ORD, Acquisition Category (ACAT) III, Increment I dated 19 February 2004, approved 1 March 04. (Ref. p. 1, JSTDS-SS TEMP)

http, //www.jpeocbd.osd.mil/page_manager.asp?pg=2&sub=17 (Nov 2007)

Light Vehicle Obscuration Smoke System (LVOSS)

Description,
The LVOSS is a self-defense smoke and riot control device externally mounted on the host vehicle. It consists of grenades, M7 Dischargers to fire the grenades, and installation kits to mount the dischargers on vehicles.

Mission,
Provide smoke protection and riot control for light vehicles. The LVOSS uses M90 smoke grenades to counter threat weapon systems operating in the visual and near-infrared portion of the electromagnetic spectrum. The system can also be used to deliver anti-riot grenades (L96A1, L97A1, M98, and M99).

Capabilities,
- Standardized discharger design for mounting on any family of light vehicle
- M304 Installation Kit installs one M7 Dischargers on M966 HMMWVs
- M305 Installation Kit installs four M7 Dischargers on M1025/M1026 HMMWVs
- M310 Installation Kit installs four M7 Dischargers on M1114 HMMWVs
- 600 coverage per discharger

Improvements over previous systems,
- Provides smoke protection to light vehicles (This capability previously did not exist for light vehicles)
- Uses grenades that are less toxic & are safer than those used on armored vehicles

Users,
U.S. Army

http, //www.jpeocbd.osd.mil/Recon/Products-CA-LVOSS.html (Nov 2007)

M45 Mask

Description,

The M45 Mask is used by all Army aircrew members except AH-64 (Apache) helicopter pilots in the conduct of aviation missions anywhere in a CB environment. The mask consists of close-fitting eye lenses, front and side voicemitters for face-to-face and telephone communication, a low profile canister interoperability hose assembly to allow both hose and face mounted configurations, a rubber facepiece with an in-turned peripheral seal, a second skin, and a hood. The mask provides the required CB protection without the aid of forced ventilation air. The M45 Mask supports the Land Warrior program and serves as the mask for personnel who cannot be fitted with the standard M40A1, M42A2, or MCU-2A/P protective masks.

Mission,

Provide aircrew and hard-to-fit personnel with protection against all known chemical and biological threat agents and radiological particulates.

User,

U.S. Army, U.S. Navy, U.S. Air Force, and U.S. Marine Corps.

Target Capabilities,

Compatible with night vision devices and aircraft sighting systems
- Microphone pass-through for aircraft communication
- Interchangeable nosecups
- Drink tube for liquid nutrients

Improvements over the M24 and M43 Type II Aircraft Masks,
- Eliminates blower and battery requirements
- Remains flexible at extreme temperatures
- Greater facial seal contact area
- Removable hose can be installed on either side of the mask

http, //www.jpeocbd.osd.mil/page_manager.asp?pg=2&sub=45 (Nov 2007)

M56 Motorized Smoke Obscurant System "The Coyote"

Description,
The M56 Smoke Generating System is the U.S. Army's first visual and infrared (IR) large area smoke generating system. The system consists of visual, infrared, and power modules mounted on the back of an M1113 High Mobility Multipurpose Wheeled Vehicle. Fog oil is pumped into the exhaust gas of a turbine engine to produce visual obscuration and graphite pellets are pulverized to 5 micron particles and disseminated through a separate ejector to produce infrared obscuration.
Mission,
Defeat all threat reconnaissance, surveillance, and target acquisition (RSTA) systems to deny the enemy information, protect forces and dominate the maneuver battle.

Capabilities,
- Simultaneous visual/IR obscuration
- Visual - 90 minutes (fog oil)
- IR - 30 minutes (graphite)
- AN/VAS-5A(V)2 Driver's Vision Enhancer
- C-130 Transportable, Air Droppable, CH-47 Sling-Load
- SINCGARS radio and AN/VIC-3 intercom

Improvements over legacy systems,
- Greater mobility
- IR capability
- Ease of operation

Users,
U.S. Army

http, //www.jpeocbd.osd.mil/Recon/Products-CA-M56Coyote.html (Nov 2007)

Discharger, Grenade, Smoke, Countermeasure, M6

Description,
The M6 is a 4-tube smoke grenade discharger that enables combat vehicles to conceal themselves from threat surveillance, target acquisition, and weapon guidance systems. It is a 2 X 2 tube design weighing 9.8 lbs.

Mission,
Provides smoke protection to armored vehicles.

Capabilities,
- Four tubes are independently addressable
- Mounts onto all armored platforms
- Capable of firing all standard 66mm smoke grenades
- 2 x 2 design
- Tubes set 14.5 degrees apart; 8"x7"x9" long; 9.8 pounds
- Cast aluminum

Improvements Over Previous Grenades,
- Individual fire control capability
- Two loaded salvos

Users,
U.S. Army

http, //www.jpeocbd.osd.mil/Recon/Products-CA-M6.html (Nov 2007)

Shipboard Collective Protection System Backfit Program

[This Information is for a more recent Shipboard CPS system, as no digital data sheet was found on the older (evaluated) CPS version for ships]

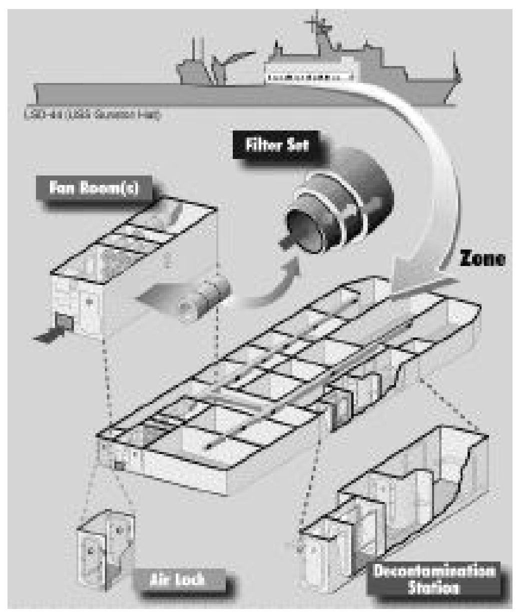
Purpose,
The shipboard Collective Protection System (CPS) Backfit Program was created to provide additional collective protection capabilities to existing amphibious class ships allowing personnel to perform mission critical operations is a Chemical, Biological, and Radiological (CBR) environment.

Major Components,
M98 Gas-particulate filter sets, pre-filter bags, filter housings, van-axial fans, fan rooms, air locks, pressure gages, zone pressure relief values, zone alarms and control panels and a decontamination station.

Mission,
The program installs additional CPS toxic free zones in critical areas including medical, command and control, rest and relief, and casualty collecting areas. Personnel working in these protected areas do not have to wear individual protective equipment (IPE) during or after a CBR attack.

Capabilities,
♦ Additional toxic free zones that allow ships personnel to operate in a CBR environment
♦ Full-time operation
♦ 3+ year filter life
♦ LHA/LHD class ships now capable of receiving and treating contaminated casualties in a collectively protected environment

User,
U.S. Navy



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